

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

Soil Science and Soil Conservation Department

“APPROVED”

Dean Land Management Faculty

_____ T. Ievsiukov
_____ 2021

REVIEWED AND APPROVED

At the Soil Science & Soil Conservation
Department, Minutes of Meeting
№ 11 from 2. 06. 2021
Head of Department, Prof. A. Balayev

_____ 2021

**WORKING TEACHING PROGRAMME
“Soil Science with Basics of Agricultural Chemistry”**

Qualification: Bachelor

Specialty: 193 Geodesy and Land Management

Land Management Faculty

Instructor: Assoc. Prof., PhD Yuriy Kravchenko

Kyiv – 2021

1.Syllabus: OB 2.1.1 Soil Science with Basics of Agrochemistry

Field of knowledge, field of study, specialty, educational-qualification level	
<i>Field of knowledge</i>	<i>19 "Architecture and building"</i>
<i>Educational-qualification level</i>	<i>Bachelor</i>
<i>Specialty</i>	<i>193 Geodesy and Land Management</i>
Course Characteristics	
Type	Optional
Total amount of hours	120
ECTS hours	4
Modules	2
Coursework	-
Mode of inspection	Exam
The course parameters for full time students	
Year of study	1
Semester	2
Lectures	30 εοδ.
Practical work	30 εοδ.
Lab work	-
Self-work	60 εοδ.
Individual work	-
Amount of contact hours per one week	4 εοδ.

Course Overview:

The course is an introductory designed course for the Bachelor student, which provides the basic concepts of all aspects of soil science. It 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.

2. Course Goal

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.

Course Objectives

Skills and mastery. Students who complete this course will be able to:

1. demonstrate understanding of the theoretical basis of agricultural chemistry and its related concepts;
2. analyze the natural processes that govern the soil genesis trend;
3. diagnose mineral and rock properties;
4. define the basic forms of relief in natural conditions;
5. describe the generation and use of natural resources;
6. 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;
7. utilize laboratory techniques to determine soil properties;
8. 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;
9. have gained the ability to retrieve and integrate soils information from a variety of sources and to utilize that information for land use and soil management decisions.

Specific topics covered in the course include the following:

- soil formation and soil taxonomy;
- soil physical properties, texture and structure;
- behavior and characteristics of water in soil; water movement and storage in soil;
- soil aeration and gas exchange;
- soil colloids (clays and organic matter), cation exchange;
- soil acidity, alkalinity, salinity;
- soil biology and ecology;
- principles of nutrient management;
- soil pollution/degradation and remediation/reclamation.

3. The course program and structure for full time students

Modules and Topics	week	hours			
		total	including		
			lec	prac	self
Module 1. General Soil Science 1					
Lecture topic 1. Introduction to Soil Science.	1	4	1	1	2
Lecture topic 2. What is soil?	1	4	1	1	2
Lecture topic 3. Soil formation and soil processes.	2	4	1	1	2
Lecture topic 4. Soil classification.	2	4	1	1	2
Lecture topic 5. Soil taxonomy and morphology.	3	4	1	1	2
Lecture topic 6. Soil physical properties 1. Texture and structure.	3	6	1	1	4
Lecture topic 7. Soil organic matter.	4	8	2	2	4
Lecture topic 8. Soil colloids.	5	4	1	1	2
Lecture topic 9. Sorption, cation and anion exchange.	5	4	1	1	2
Lecture topic 10. Soil acidity and alkalinity.	6	8	2	2	4

Lecture topic 11. Soil salinity.	7	6	2	2	2
<i>Total for Module 1</i>	7	58	14	14	28
Module 2. General Soil Science 2					
Lecture topic 12. Soil physical properties 2. Soil structure, soil density, pore space, impacts of tillage.	8	6	2	2	2
Lecture topic 13. Soil water.	9	6	1	1	4
Lecture topic 14. Soil and the hydrologic cycle.	9	4	1	1	2
Lecture topic 15. Soil climate. Soil air and temperature	10	4	1	1	2
Lecture topic 16. Soil ecology.	10	6	1	1	4
Lecture topic 17. Soil productivity and its evaluation.	11	6	2	2	2
Lecture topic 18. Soils of the Forest Zone of Ukraine.	12	8	2	2	4
Lecture topic 19. Soils of the Forest-Steppe zone of Ukraine.	13	6	2	2	2
Lecture topic 20. Soils of the Steppe zone of Ukraine.	14	6	2	2	2
Lecture topic 21. Alluvial and Meadow Soils.	15	6	1	1	4
Lecture topic 22. Saline soils.	15	6	1	1	4
<i>Total for Module 2</i>	8	64	16	16	32
<i>Total for course</i>	15	120	30	30	60

4. Modules and lectures

Module 1. GENERAL SOIL SCIENCE 1

Lecture topic 1. Introduction to Soil Science (1 hr.).

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

Lecture topic 2. What is soil? (1 hr.).

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. Primary and secondary minerals. Small biological and big geological cycles.

Lecture topic 3. Soil formation and soil processes (1 hr.).

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.

Lecture topic 4. Soil classification (1 hr.).

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.

Lecture topic 5. Soil taxonomy and morphology (1 hr.).

Taxonomy units of genetic classification: type, subtype, genious, spieces, soil texture, lithologic seria. Climatic, hydrological and biological principles of soil diagnostics. Morphologic-genetic, chemical and other indexes of soil diagnostics.

Lecture topic 6. Soil physical properties 1. Texture and structure (1 hr.).

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.

Lecture topic 7. Soil organic matter (2 hrs.).

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.

Lecture topic 8. Soil colloids (1 hr.).

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.

Lecture topic 9. Sorption, cation and anion exchange (1 hr.).

Mechanical, physical, exchangeable, chemical, biological retention. A role of calcium, iron, sodium and other cations and dispersion matters in the processes of soil absorption. A role of absorbed cations in soil formation. 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.

Lecture topic 10. Soil acidity and alkalinity (2 hrs.).

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.

Lecture topic 11. Soil salinity (2 hrs.).

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 2

Lecture topic 12. Soil physical properties 2 (2 hrs.).

Soil structure, soil density, pore space, impacts of tillage.

Soil aggregates classification. Agronomically favorable structural aggregates. Aggregates coagulation and disintegration. Aggregates within different soils, soil horizons. Dry and wet aggregate analysis. Particle density, bulk density, determination and analytical procedure. Optimum values of the bulk density. Soil porosity. Total, aeration, capillary porosity determination. Soil's resistance to tillage. Soil's physical maturity for tillage. Soil hardness.

Lecture topic 13. Soil water (1 hr.).

A role of water in plant growing, vital functions of animals and microorganisms. State, forms of connection and category of water in soil. Features of connection of water with the solid phase of soil, chemical matter, molecules and ions. 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.

Lecture topic 14. Soil and the hydrologic cycle(1 hr.).

Soil Productive water content evaluation. Soil water balance, regimes. Soil water management.

Lecture topic 15. Soil climate. Soil air and temperature (1 hr.).

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.

Lecture topic 16. Soil ecology (1 hr.).

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.

Lecture topic 17. Soil productivity and its evaluation (2 hrs.).

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.

Lecture topic 18. Soils of the Forest Zone of Ukraine (2 hrs.).

Soddy-Podzolic, Sod, Swampy soils. Classification, genesis, properties, management.

Lecture topic 19. Soils of the Forest-Steppe zone of Ukraine (2 hrs.).

Grey forest soils, Podzolized, Leached, Typical Chernozems. Classification, genesis, properties, management.

Lecture topic 20. Soils of the Steppe zone of Ukraine (2 hrs.).

Ordinary and Southern Chernozems. Classification, genesis, properties, management. Chestnut soils. Classification, genesis, properties, management.

Lecture topic 21. Alluvial and Meadow Soils (1 hr.).

Meadow-chernozems, meadow, soddy, swampy, alluvial soils. Classification, genesis, properties, management.

Lecture topic 22. Saline soils (1 hr.).

Solonchak, solonetz, solod. Classification, genesis, properties, management.

5. Lab classes

Type of work	Hours
<i>Module 1. General Soil Science 1</i>	
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
<i>Module 2. General Soil Science 2</i>	
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

6. Assignments for self-organized student activity

<p>Self-work 1.1. Soil Solids and Soil Organic matter. <i>Purpose:</i> The purpose of this exercise is to learn about soil particles and soil organic matter <i>Learning Outcomes:</i> upon completion of this exercise students will be able to define: soil water categories, hygroscopic moisture, soil particles, soil textural classes, soil organic matter and its composition. Exercises: 1 – 57.</p> <ol style="list-style-type: none"> 1. What is the purpose of soil sampling? 2. Why and how is hygroscopicity coefficient computed? 3. On which factors and how does soil hygroscopic moisture depend? 4. Speak on soil sample preparation for organic carbon (humus) determination. 5. What is hygroscopic moisture of the soil sample? 6. Speak on soil sample preparation for mechanical (particle size) analysis. 7. Speak on the agronomic importance of maximal hygroscopicity. 8. Speak on the safety during soil sample processing. 9. Speak on the analytical procedure of soil hygroscopic moisture determination. 10. What is permanent wilting point (PWP) and conventional way of its computation? 11. What is hygroscopicity coefficient? 12. On what factors depends the procedure of soil sampling in the field? 13. Why particle size analysis (PSA) is one of the most requested analysis in soil characterization? 14. Describe the field method of soil texture diagnostics. 15. Speak on particle size classification by N.A.Kachinsky. 16. Give reasons for dividing elementary soil particles into physical sand and physical clay. 17. Describe the sizes and properties of clay. 18. Describe the % content of physical clay in loamy sand. 19. Differentiation degree of soil profile. 20. What information is needed to determine soil texture group by Kachinsky's classification? 21. Describe analytical procedure of a pipette method. 22. Derive sedimentation equation based on Stokes' law. 23. Explain the use of a hydrometer for particle size analysis in the USA. 24. Describe the sizes and properties of silt. 25. Describe the % content of physical clay in loam. 26. Potential ability of soils to aggregate formation. 27. Describe textural triangle and explain how to use it for soil texture determination. 28. Agronomic importance of soil texture. Crop responses to soil texture. 29. Speak on soil texture classification by N.A.Kachinsky. 30. Weak points of granulometry based on Stokes' law. 31. Describe the sizes and properties of sand. 32. Describe the % content of physical clay in clay. 33. Differentiation coefficient of soil profiles. 34. Speak on the forms of SOM as presented by D.S.Orlov. 35. Describe wet combustion method of SOM determination by I.V. Tyurin's procedure. 36. How to evaluate SOM amount by the scale proposed by L.A.Grishina and D.S.Orlov? 37. How to compute and express SOM determination results? 38. Factors of soil formation. 39. Types of soil humus. 40. Describe the properties of Fulvic Acids. 41. How to compute the amount of SOM (humus) in a layer of soil in mt/ha? 42. How to evaluate SOM content by the scale proposed by L.A.Grishina and D.S.Orlov? 43. Speak on the SOM content and amount in Ukrainian soils. 44. Speak on the agronomic and soil-protecting roles of soil humus? 45. Speak on the "group composition" and "type" of soil humus. 46. Speak on soil humus as a colloidal matter. 47. Speak on the environmental significance of a humosphere. 48. Speak on the agronomic practices of SOM conservation. 49. General scheme of soil formation. 50. Humification. 51. Describe the properties of Humic Acids. 52. Soil as a medium for plant growth. 53. Sources and composition of SOM. 54. Describe the properties of Humin. 55. Soil as a medium for plant growth. 56. Sources and composition of SOM. 57. Describe the properties of Humin. <p>Report: downloaded/typed word file.</p>	<p>Self-work 2.1. Soil Survey. <i>Purpose:</i> The purpose of this exercise is to learn about soil genesis and soil management <i>Learning Outcomes:</i> Upon completion of this exercise students will be able to provide a soil quality assessment and apply a proper soil management.</p> <p><i>Background:</i> textbook and methodical instructions (see Module 3 Data Base).</p> <p><i>Exercise.</i> Describe the soils of a place of study (home place) by the following criteria:</p> <ul style="list-style-type: none"> – geographical position, – soil genesis (soil forming factors and processes), – soil properties and soil quality, – soil management.
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7. Students' knowledge control by questions

- Soil Genesis. Soil development stages: youth, juvenile, mature, adult and old age “senile” soil age sequence. Soil forming factors. Weathering and soil parent material formation. Soil profile organization. Soil morphology. Soil composition. Soil processes are within a soil profile. Pedon and polypedon. Soil functions. Soil as a medium for plant growth. Soil cover and practices of soil and land importance in your native locality. Taxonomic units and soil classifications of Ukraine and FAO system.
- Soils of the Forest-Steppe zone of Ukraine. Classification, genesis, properties, management.
- Soils of Steppe zone of Ukraine. Classification, genesis, properties, management.
- Soils of the Forest zone of Ukraine. Classification, genesis, properties, management.
- Salt-affected soils (solonchak, solonez, solod). Classification, genesis, properties, management.
- Soddy-Podzolic, Sod, Swampy, soils. Classification, genesis, properties, management.
- Chernozems. Classification, genesis, properties, management.
- Grey forest soils. Classification, genesis, properties, management.
- Kastanozems. Solonchak, solonetz, solod. Classification, genesis, properties, management.
- Meadow-chernozems, meadow, soddy, swampy, alluvial soils (flooding plain soils).
- Flooding plain soils (meadow-chernozems, meadow, soddy, swampy, alluvial). Classification, genesis, properties, management.
- Soil Organic Matter. SOM Determination. A classification scheme for soil organic matter. Sources of SOM and its composition. 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.
- 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. Soil Productive water content evaluation. Soil water balance, regimes. Soil water management.
- 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.
- Soil Acidity and Alkalinity. Sources of 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.
- Soil physical properties. Particle density, bulk density, determination and analytical procedure. Optimum values of the bulk density. Soil porosity. Total, aeration, capillary porosity determination. Soil's resistance to tillage. Soil's physical maturity for tillage. Soil hardness.
- Soil Acidity and Alkalinity. Sources of 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.
- Soil solution. 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.
- Soil structure. Soil aggregates classification. Agronomically favorable structural aggregates. Aggregates coagulation and disintegration. Aggregates within different soils, soil horizons. Dry and wet aggregate analysis. Physical and mechanical characteristics of soils.
- Soil structure. Soil aggregates classification. Agronomically favorable structural aggregates. Aggregates coagulation and disintegration. Aggregates within different soils, soil horizons. Dry and wet aggregate analysis. Physical and mechanical characteristics of soils.
- Soil productivity and its evaluation. Essential Criteria. The typical soil grades in points (0-100). Etalon of grades. The prices of the grades of soil evaluation. Weighted average grade (Bt). 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.
- Soil Colloids and retention capacity. Soil colloids, their structure, properties, composition. Dispersion, coagulation capacity. Mechanical, physical, exchangeable, chemical, biological retention. The energy of ions sorption. Cation exchange capacity. Cation composition of Ukrainian soils. Base saturation percent.

8. Exam test control

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
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	$BSP = S + Hh / S * 100$
3	$BSP = S - Hh$
4	$BSP = S / Hh * 100$

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^{3+}
3	Ca^{2+}
4	K^+

8. Match soil parameters and productivity characteristics according to the scale A.L.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

The teaching of soil science is no longer being confined to its traditional founding in agriculture and agronomy, and is now included in disciplines or majors like: fundamental physics and chemistry, botany, forestry, geology, ecology, hydrology, cartography, geography and resource sustainability. The content of soil science is uneasily placed between natural science on the one hand, and the world of professional practice on the other. This course is provided with a new set of tools and techniques available by which we investigate soils, and the foci are shifting toward other disciplines and changing research questions. That course offers a number of training opportunities. The fundamental soil science is provided with unique hands on experience standard methods and technologies included: soil field and lab testing, soil survey studying, soil morphology analysis, soil taxonomy and classification approaches, agronomy assessment of soil fertility, soil sensing, active optical sensor networks, etc.

Students in cooperation with faculty partners develop and implement comprehensive solutions to increase the efficiency of agribusiness. They select the tools that allow our clients to get more profit from each hectare of land: soil analysis, agro-diagnostics, soil and crop monitoring, agricultural practices increasing soil fertility and a content of a soil organic carbon, as well as modern software and equipment used in conservation resilient agriculture.

As such, 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. The module-rating system

Оцінювання студента відбувається згідно положенням «Про екзамени та заліки у НУБіП України» (протокол № 4 від 28 листопада 2019 р.) і наказом ректора від 29.11.2019 р. № 1326 воно уведено в дію з 1 грудня 2019 р. Навчальна робота оцінюється в 70 балів, атестація – 30 балів.

The module-rating system, as part of the University's quality assurance procedures, stirring up the student auditorium and self-work. Principle of module training is that training material of the course is divided into logical content modules completed on a base of theoretical material and practical work. Amount of modules in this course are 2.

Modules		Educational work	Final attestation exam	Total
I module	II module			
100	100	70	30	100

The total rating of soil science course is estimated as : $R_{total} = R_{ed} + R_{at}$, where, R_{ed} – rating of educational work, R_{at} – final attestation exam. The rating of educational work is calculated by summarizing of all module points, dividing them on their amount and multiplying them on factor - 0.7. For ex., $R_{ed} = (I \text{ module} + II \text{ module}/2) \times 0.7$.

11. The principles of module assessment

Type of work	Point	Average weighted point
<i>Module 1. General Soil Science 1 (60 hrs.)</i>		
Educational work		
Lab 1. Soil sampling. Lab Safety.	7	2,45 %
Lab 2. Forms (categories) of soil water. Soil hygroscopic moisture determination.	4	1,4 %
Lab 3. Soil granulometry and particle size distribution.	7	2,45 %
Lab 4. International pipette method of soil texture determination.	8	2,8 %
Lab 5-6. Feel and hydrometer methods of soil texture determination.	6	2,1 %
Lab 7. Soil organic matter lab determination.	8	2,8 %
Self work of Module 1		
Self-work 1.1. Soil Solids and Soil Organic matter	20	7 %
Mid-term exams of Module 1		
Pretest Module 1. Soil Components and SOM	0	0
<i>Test Module 1 Soil Components and SOM</i>	40	14 %
Total for Module 1	100	35 %
<i>Module 2. General Soil Science 2 (60 hrs.)</i>		
Educational work		
Lab 8. Soil organic matter evaluation.	5	1,75 %
Lab 9. Soil acidity determination.	5	1,75 %
Lab 10. Cation exchange capacity determination.	5	1,75 %
Lab 11. Soil alkalinity and salinity.	5	1,75 %
Lab 12. Soils of the Forest and Forest-Steppe zones of Ukraine.	5	1,75 %
Lab 13. Saline Soils and Soils of the Steppe zone of Ukraine.	5	1,75 %
Lab 14. Wet and mountain soils of Ukraine.	5	1,75 %
Lab 15. Soil Productivity Evaluation.	5	1,75 %
Self work of Module 2		
Self-work 2.1. Soil Survey.	20	7 %
Mid-term exams of Module 2		
PreTest Module 2. General Soil Science	0	0
Test Module 2. General Soil Science	40	14 %
Total for Module 2	100	35 %
<i>Final grading</i>		
FINAL COURSE EXAM	100	30 %
Total for course	300	100 %

Ratio between student's rating and the Ukrainian National grades

The Ukrainian National Grades	Student's rating, points
«Excellent»	≥ 90
«Good»	82-90
	74-82
«Satisfactory»	64-74
	60-64
«Unsatisfactory»	35-60
	≤ 35

12. Literature

Textbooks:

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.] / Henry D. Foth // 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. Ґрунтознавство з основами геології: Підручник / [Назаренко І.І., Польчина С.М., Дмитрук Ю.М. та ін.]. Чернівці: Книги – XXI, 2006. 504 с.

Laboratory books:

1. Petrenko L., Berezhniak M., Kravchenko Yu., Tonkha O., Berezhniak Ie., Vykova O. Soil Science : Practical Methods Manual / [L. Petrenko, M. Berezhniak, Yu. Kravchenko та ін.]. – NUBIPU Publishing Center, Kyiv, 2013. – 429 pp.
2. Гнатенко О.Ф., Петренко Л.Р., Капшик М.В. Ґрунтознавство з основами геології: Метод. рекоменд. до вивчення курсу лекцій і лаборат. занять. – К.: НАУ, 1997. – 78 с.

Additional literature:

1. Атлас почв Украинской ССР. Под ред. Н.К. Крупского, Н.И. Полупана.-К.: Урожай, 1979.-160с.
2. Kravchenko Y.S. Geology with the principles of Geomorphology. Part 1. Dynamic Geology. Київ, ТОВ "Центр ІТ». – 2009. – 142 с.
3. Тихоненко Д.Г. Геологія з основами мінералогії : навч. посібник / Д. Г. Тихоненко, В. В. Дегтярьов, М. А. Щуковський та ін.; За ред. д-ра с. -г. наук, проф. Д. Г. Тихоненка. – К.: Вища освіта, 2003. — 287 с.
4. Картографія ґрунтів: підручничик [для студ. Агроном., еколог., інженер., спец. Вищих навч. закл. освіти III-IV рівнів акредитації]/(Тихоненко Д.Г., Дегтярьов В.В., Горін М.О., Веремеєнко С.І., Фурман В.М., Гавва Д.В.); за ред. Д.Г.Тихоненка; ред-укл. М.О.Горін.- (з-те вид., допов. і перероб.)- Х.:Майдан, 2014.-394с.:іл.

Internet sources

1. World Reference Base for Soil Resources 2014. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome. 181 p. (<http://www.fao.org/3/a-i3794e.pdf>).
2. Soil Map of Ukraine