



The National Technical University of  
Ukraine "Igor Sikorsky Kyiv Polytechnic  
Institute"



Department of Ecology and  
Technology of Plant  
Polymers

## Geodynamics of the ecological environment. Part 1. Soil Science

### Work program of the credit module (Syllabus)

#### Details of the credit module

Level of higher education	<i>First (bachelor's)</i>
Branch of knowledge	<i>10 Natural sciences</i>
Speciality	<i>101 Ecology</i>
Educational program	<i>Ecological safety</i>
Status of credit module	<i>Normative</i>
Form of training	<i>full-time(day) /remote/mixed</i>
Year of preparation, semester	<i>1nd year, spring semester</i>
Volume of credit module	<i>3(90)</i>
Semester control/ control measures	<i>Test</i>
Schedule of classes	<i>3 hours a week (2 hours of lectures and 1 hour of laboratory classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about kerivnik course / teachers	<i>Lecturer: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html</a> Laboratory: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html</a></i>
Course placement	<i><a href="https://do.ipk.kpi.ua/course/view.php?id=2726">https://do.ipk.kpi.ua/course/view.php?id=2726</a></i>

#### Program of credit module

##### 1. Description of the credit module, its purpose, subject of study and learning results

**Soil Science** - a science that studies the composition, condition, structure and properties of soils as any rocks and man-made formations or their constituent soil strata, patterns of their formation and spatio-temporal changes under the influence of modern and predicted geological processes formed during development of the earth's crust under the influence of all natural factors and in connection with the engineering and economic, primarily engineering and construction activities of mankind.

The subject of the credit module "**Geodynamics of the ecological environment. Part 1. Soil Science**"- knowledge of ecological and genetic bases of formation, functioning and development of soils. The object of research in soil science are soils, factors of their formation, composition, properties, productivity of soils, their rational use and protection.

**The purpose of the credit module "Geodynamics of the ecological environment. Part 1. Soil Science"**

The purpose of studying this credit module is to form in students a set of knowledge in the field of soil science as a fundamental natural history science, which meets the needs of agriculture, forestry, water, utilities and other sectors of the economy. Soil science is studied in the context of actualization of environmental problems, specified through the cultivation of soils, increasing their fertility, protection against degradation and pollution, rational use and protection.

In accordance with the purpose of training bachelors requires the formation of students with the following competencies:

- Knowledge and understanding of the theoretical foundations of ecology, environmental protection and sustainable use of nature;
- Ability to critically comprehend the basic theories, methods and principles of natural sciences;
- Ability to justify the need and develop measures aimed at preserving landscape and biological diversity and the formation of ecological network.

According to the requirements of the program of the credit module **"Geodynamics of the ecological environment. Part 1. Soil Science"**, students after mastering it must demonstrate the following program learning outcomes:

- Understand the basic environmental laws, rules and principles of environmental protection and nature management;
- Understand the basic concepts, theoretical and practical problems in the field of natural sciences, which are necessary for analysis and decision-making in the field of ecology, environmental protection and optimal use of nature;
- Identify the factors that determine the formation of landscape and biological diversity;
- Choose the optimal strategy for holding public hearings on the problems and formation of the territories of the nature reserve fund and the ecological network;
- Raise the professional level by continuing education and self-education;
- Demonstrate skills in implementing environmental measures and projects.

## **2. Prerequisites and requisition of credit modules (place in the structural and logical scheme of training according to the relevant educational program)**

Study of the credit module **"Geodynamics of the ecological environment. Part 1. Soil Science"** is based on the principles of integration of various knowledge acquired by students during the bachelor's degree in the study of natural and engineering credit modules: "Chemistry with the basics of biogeochemistry", "Physics", "Special sections of biogeochemistry", "General Ecology".

Credit module **"Geodynamics of the ecological environment. Part 1. Soil Science"** is a fundamental basis for the study of the following credit modules: "Hydrology", "Environmental Monitoring", "Transformation of chemicals in the geosphere", "Biogeochemistry", "Migration of toxicants in the biosphere".

## **3. Contents of the credit module**

### **Section 1. Introduction to the course of Soil Science.**

**Topic 1.** Subject and objectives of the course. The concept of soil. The main provisions of science. Methodology and methods of soil research. Historical review of soil study. Development of soil science in Ukraine. The value of soil science for environmental protection.

### **Section 2. Soil morphology and physics.**

**Topic 1.** Phase composition of the soil. Morphological structure of soil, its structure, particle size distribution. Soil profile and horizons. Transitions between horizons in the profile. The main

morphological features of genetic horizons (color, structure, composition, neoplasms and inclusions). Indexing of horizons.

**Topic 2.** Weathering of rocks. Soil-forming rocks. Primary and secondary minerals. Physical properties of soils. Categories of soil formation of rocks. Plasticity, swelling, stickiness of soils.

### **Section 3. Soil chemistry.**

**Topic 1.** Chemical composition of soils. General chemical composition of soils. Chemical elements and their compounds in soils. Trace elements in soils.

**Topic 2.** Organic soil. Sources of humus in the soil. The process of humus formation. Regulation of its content in the soil. Composition and properties of soil. Organo-mineral compounds. Group and fractional composition of soil.

**Topic 3.** Soil colloids. Soil absorption capacity. Physical state of colloids in soil, types of absorptive capacity. Ecological and geographical properties of soil, soil absorption complex and its characteristics.

### **Section 4. Physico-chemistry of soil.**

**Topic 1.** Liquid and gaseous phases of soil. Condition and forms of water in the soil. Water and physical properties of soil. Ground air. Soil solution. Acidity and alkalinity of soils, their forms. Redox regime of soils.

### **Section 5. Soil fertility.**

**Topic 1.** Factors and patterns of natural soil fertility. Categories of fertility. Increasing soil fertility. The law of "declining fertility" and its critique.

### **Section 6. Soil formation.**

**Topic 1.** Factors of soil formation. The role of living organisms in soil formation. The role of microorganisms in soil formation. The role of soil fauna in soil formation. Biogenic structure formation. Climate as a factor of soil formation. Features of climatic soil formation. Water regime of soils. Thermal regime of soils. Thermal properties of soils. The role of the parent rock, terrain and terrain in soil formation. Anthropogenic factors of soil formation.

### **Section 7. Biogeochemistry of soil formation.**

**Topic 1.** Features of the Earth's biosphere. Structure, properties and structure of natural systems. Large geological cycle of substances. Small biological cycle of substances. Migration flows of elements. Geochemical barriers and reservoirs.

**Topic 2.** Soil formation as a biosphere process. General scheme of soil formation. Balance of soil formation. The concept of elementary soil-forming processes. Biogenic-accumulative, hydrogen-accumulative, metamorphic, eluvial and illuvial-accumulative soil-forming processes.

### **Section 8. Systematics and classification of soils.**

**Topic 1.** Classification of soils. The concept of soil classification. Taxonomic units in the classification of patterns of soil distribution on Earth. Types and subtypes of soils, genus and species and variety, category and subclass of soils.

**Topic 2.** Systematization of soils. Fundamentals of soil-geographical zoning. Soil and bioclimatic zones, regions, zones, provinces, districts, districts. Soil-geographical zoning and general scheme of soil cover of Ukraine.

### **Section 9. Soils of subboreal areas.**

**Topic 1.** Soils of forest and steppe regions. Brown forest, gray forest soils. Chernozems of forest-steppe and steppe. Saline soils, salt marshes, salt marshes.

### **Section 10. Soil protection.**

**Topic 1.** Erosion, deflation and soil compaction. Tasks of soil protection. Pathology of soil profile and genetic horizons. Protection of soils from erosion and deflation and overcompaction. Reclamation of disturbed landscapes.

**Topic 2.** Violation of the bioenergetic regime of edaphotopes. Soil protection from devegetation and dehumidification. Soil fatigue, soil depletion and toxicosis. Violation of water and chemical regime of edaphotopes.

**Topic 3.** Violation of water and chemical regime of edaphotopes. Desertification of soils, villages and landslides. Secondary acidity of soils. Protection of soils from overdrying. Pollution and chemical poisoning of soils.

**Topic 4.** Protection of soils from contamination by agrochemicals and products of technogenesis. Phytoindication of fertility and edaphic grid (for forest soils). Typification of fertility factors. Potential fertility. Effective fertility. Complete fertility.

#### **4. Training materials and resources**

##### **Basic literature**

1. Soil protection system against erosion. Textbook. For order Pilipenko O.I. - Kyiv: Condor Publishing House, 2019. - 372 p.
2. Soils of Ukraine: properties, genesis, fertility management / V.I. Kupchyk, V.V. Ivanina, G.I. Nesterov, etc .; Textbook. For order V.I. Kupchyk. - Kyiv: Condor Publishing House, 2016. - 414 c.
3. Methodical instructions for practical work on the course "Soil Science" for students in the direction of training 6.040106 "Ecology, environmental protection and sustainable use of nature" / Encl. Ivanenko O.I., Wember V.V. Kyiv: LLC "Infodruk", 2012. 43p.
4. Methodical instructions for independent work on the course "Soil Science" for students in the direction of training 6.040106 "Ecology, environmental protection and sustainable use of nature" / Encl. Ivanenko O.I. 2012. 12p.

##### **Additional literature**

5. Poznyak S.P. Soil science and geography of soils: a textbook. Part 1. Lviv: Ivan Franko Lviv National University. 2010. 270 p.
6. Poznyak S.P. Soil science and geography of soils: a textbook. Part 2. Lviv: Ivan Franko Lviv National University. 2010. 270 p.
7. Gnatenko O.F. Soil science with the basics of geology. - Kyiv: Oranta, 2005. - 648 p.
8. Nazarenko N.N., Polchina S.M. Pedology. - Chernivtsi: Ruta, 2003.
9. Field research and soil mapping. Polchina S.M.: Textbook. pos. - Kyiv: Condor Publishing House, 2009. - 224 p.
10. Kovda V.A., Rozanov B.G. Soil science. - Moscow: Higher School, 1989.

##### **Information resources on the Internet**

11. Ministry of Environmental Protection and Natural Resources of Ukraine - <https://mepr.gov.ua/>
12. Industrial Ecology. Community of environmental specialists - <http://www.eco.com.ua/>
13. Professional Association of Ecologists of Ukraine (PAAU) - <https://paeu.com.ua/>
14. Бібліотека ім. В.І. Вернадського – [www.nbuv.gov.ua](http://www.nbuv.gov.ua)
15. Екологічний портал України – [www.ecologya.com.ua](http://www.ecologya.com.ua)

## 5. Methods of mastering the credit module

### Lecture classes

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge in the credit module "**Geodynamics of the ecological environment. Part 1. Soil Science**", the level of which is determined by the target installation for each specific topic;
- providing in the process of lecture creative work of graduate students together with the teacher;
- education of postgraduate professional and business qualities and development of their independent creative thinking;
- formation of the necessary interest from graduate students and providing direction for independent work;
- determination at the current level of science development in the field of modern methods and processes of air conditioning, forecasting development for the coming years;
- display of methodological processing of the material (allocation of the main provisions, conclusions, recommendations, clear and adequate to their formulations);
- use for demonstration of visual materials, combining, if possible, them with the demonstration of results and samples;
- teaching research materials in a clear and high-quality language in compliance with structural and logical relations, explaining all the newly introduced terms and concepts;
- accessibility for perception by this audience.

No s/p	<b>Title of the lecture topic and list of main questions (list of didactic means, references to literature and tasks on the SRS)</b>	Hours
1	<p><b>Subject and objectives of the course</b></p> <p>The concept of soil. The main provisions of science. Methodology and methods of soil research.</p> <p>References: [8] p. 3-23</p> <p>IWS - Historical review of soil study. Development of soil science in Ukraine. The value of soil science for environmental protection.</p>	2
2	<p><b>Phase composition of the soil</b></p> <p>Morphological structure of soil, its structure, particle size distribution. Soil profile and horizons. Transitions between horizons in the profile.</p> <p>References: [5] p. 95-115, [8] p. 28-51</p> <p>IWS - The main morphological features of genetic horizons (color, structure, composition, neoplasms and inclusions). Indexing of horizons.</p>	2
3	<p><b>Weathering of rocks</b></p> <p>Soil-forming rocks. Primary and secondary minerals. Physical properties of soils.</p> <p>References: [5] p. 117-135; [8] p. 52-71</p> <p>IWS - Categories of soil formation of rocks. Plasticity, swelling, stickiness of soils.</p>	2
4	<p><b>Chemical composition of soils</b></p> <p>General chemical composition of soils. Chemical elements and their compounds in soils.</p> <p>References: [5] p. 143-145; [8] p. 72-77</p> <p>IWS - Trace elements in soils.</p>	2

5	<p><b>Organic material of the soil</b></p> <p>Sources of humus in the soil. The process of humus formation. Regulation of its content in the soil.</p> <p>References: [5] p. 147-170; [8] p. 77-93</p> <p>IWS - Composition and properties of soil. Organo-mineral compounds. Group and fractional composition of soil.</p>	2
6	<p><b>Soil colloids</b></p> <p>Soil absorption capacity. Physical state of colloids in soil, types of absorptive capacity.</p> <p>References: [5] p. 171-180; [8] p. 94-107</p> <p>IWS - Ecological and geographical properties of soil, soil absorption complex and its characteristics.</p>	2
7	<p><b>Liquid and gaseous phases of soil</b></p> <p>Condition and forms of water in the soil. Water and physical properties of soil. Ground air.</p> <p>References: [5] p. 191-217; [8] p. 108-133</p> <p>IWS - Soil solution. Acidity and alkalinity of soils, their forms. Redox regime of soils.</p>	2
8	<p><b>Soil fertility</b></p> <p>Factors and patterns of natural soil fertility. Categories of fertility.</p> <p>References: [5] p. 245-254; [8] p. 134-140</p> <p>IWS - Increasing soil fertility. The law of "declining fertility" and its critique.</p>	2
9	<p><b>Factors of soil formation</b></p> <p>The role of living organisms in soil formation. The role of microorganisms in soil formation. References: [5] p. 46-53; [8] p. 141-150</p> <p>IWS - The role of soil fauna in soil formation. Biogenic structure formation.</p>	2
10	<p><b>Climate as a factor of soil formation</b></p> <p>Features of climatic soil formation. Water regime of soils. Thermal regime of soils.</p> <p>References: [5] p. 30-46; [8] p. 151-162;</p> <p>IWS - Thermal properties of soils. The role of the parent rock, terrain and terrain in soil formation. Anthropogenic factors of soil formation.</p>	2
11	<p><b>Features of the Earth's biosphere</b></p> <p>Structure, properties and structure of natural systems. Large geological cycle of substances. Small biological cycle of substances.</p> <p>References: [5] p. 65-68; [8] p. 164-176</p> <p>IWS - Migration flows of elements. Geochemical barriers and reservoirs.</p>	2
12	<p><b>Soil formation as a biosphere process</b></p> <p>General scheme of soil formation. Balance of soil formation. The concept of elementary soil-forming processes.</p> <p>References: [5] p. 62-65; [8] p. 177-190</p> <p>IWS - Biogenic-accumulative, hydrogen-accumulative, metamorphic, eluvial and illuvial-accumulative soil-forming processes.</p>	2



13	<p><b>Classification of soils</b></p> <p>The concept of soil classification. Taxonomic units in the classification of patterns of soil distribution on Earth.</p> <p>References: [5] p. 255-262; [8] p. 193-196</p> <p>IWS - Types and subtypes of soils, genus and species and variety, category and subcategory of soils.</p>	2
14	<p><b>Systematization of soils</b></p> <p>Fundamentals of soil-geographical zoning. Soil and bioclimatic zones, regions, zones, provinces, districts, districts.</p> <p>References: [6] p. 11-36; [8] p. 196-200</p> <p>IWS - Soil-geographical zoning and the general scheme of soil cover of Ukraine.</p>	2
15	<p><b>Soils of subboreal areas</b></p> <p>Soils of forest and steppe regions. Brown forest, gray forest soils. Chernozems of forest-steppe and steppe.</p> <p>References: [6] p. 85-115; [8] p. 236-258</p> <p>IWS - Saline soils, salt marshes, salt marshes.</p>	2
16	<p><b>Erosion, deflation and soil compaction</b></p> <p>Tasks of soil protection. Pathology of soil profile and genetic horizons. Protection of soils from erosion and deflation and overcompaction. Reclamation of disturbed landscapes.</p> <p>References: [6] p. 243-255; [8] p. 314-326</p> <p>IWS - Violation of the bioenergetic regime of edaphotopes. Soil protection from devegetation and dehumidification. Soil fatigue, soil depletion and toxicosis.</p>	2
17	<p><b>Violation of water and chemical regime of edaphotopes</b></p> <p>Violation of water and chemical regime of edaphotopes. Desertification of soils, villages and landslides. Secondary acidity of soils.</p> <p>References: [6] p. 256-257, 265-267; [8] p. 329-343</p> <p>IWS - Protection of soils from overdrying</p>	2
18	<p><b>Pollution and chemical poisoning of soils</b></p> <p>Protection of soils from contamination by agrochemicals and products of technogenesis.</p> <p>References: [6] p. 259-263; [8] p. 337-344</p> <p>IWS - Phytoindication of fertility and edaphic grid (for forest soils). Typification of fertility factors. Potential fertility. Effective fertility. Complete fertility.</p>	2
	Total	36

### **Laboratory classes**

In the system of professional training of students, laboratory classes occupy 33% of the classroom workload. As a supplement to the lecture course, they lay and form the basis of the bachelor's degree in ecology. The content of these classes and methods of conducting them should ensure the development of creative activity of the individual. They develop scientific thinking and the ability to use special terminology, allow you to test knowledge, in connection with which this type of work is an important means of operational feedback. Therefore, laboratory classes should

perform not only cognitive and educational functions, but also promote the growth of students as creative workers in the field of ecology. The main tasks of the cycle of laboratory classes:

- to help students to systematize, consolidate and deepen the knowledge of a theoretical nature in the cycle of environmental credit modules;
- to teach students the techniques of solving practical problems, to promote the acquisition of skills and abilities to identify the type of situation and assess the level of danger, and on the basis of analysis of processed information, to come to their own reasonable conclusions;
- teach them to work with scientific and reference literature, documentation and schemes;
- to form the ability to learn independently, ie to master the methods, ways and techniques of self-learning, self-development and self-control.

<b>No s/p</b>	<b>Name of laboratory work</b>	<b>Hours</b>
1	Determination of soil color and soil-forming rock.	2
2	Determination of mechanical (particle size) composition of soil and soil-forming rock.	2
3	Determination of soil structure.	2
4	Identification of tumors and inclusions in the soil.	2
5	Determination of soil acidity.	2
6	Determination of soil density by the method of cutting ring.	2
7	Determination of porosity and porosity of soil by saturation.	2
8	Determining the structure of the profile and the name of the soil.	2
9	Carrying out modular control test.	2
<b>Total hours</b>		<b>18</b>

## 6. Independent work of a student

Independent work takes 40% of the time to study the credit module, including preparation for the test. The main task of independent work of students is to master scientific knowledge in areas that are not included in the list of lecture questions by personal search for information, the formation of active interest in the creative approach in educational work. In the process of independent work within the educational component, the student must learn to deeply analyze modern approaches to solving practical problems that contribute to the rational use of natural resources, protection and preservation of soil fertility.

<b>No s/p</b>	<b>Name of the topic submitted for self-study</b>	<b>Number of hours of IWS</b>
<b>Section 1. Introduction to the course of soil science</b>		
1	Historical review of soil study. Development of soil science in Ukraine. The value of soil science for environmental protection. References: [5] p. 11-27; [8] p. 7-20	2
<b>Section 2. Soil morphology and physics</b>		
2	The main morphological features of genetic horizons (color, structure, composition, neoplasms and inclusions). Indexing of horizons. References: [5] pp.106-115; [8] p. 28-51	3



	<i>Categories of soil formation of rocks. Plasticity, swelling, stickiness of soils. References: [8] p. 52-71</i>	
<b>Section 3. Soil chemistry</b>		
3	<i>Trace elements in soils. References: [8] p. 71-76 Composition and properties of soil. Organo-mineral compounds. Group and fractional composition of soil. References: [8] p. 77-93 Ecological and geographical properties of soil, soil absorption complex and its characteristics. References: [8] p. 94-107</i>	5
<b>Section 4. Physico-chemistry of soil</b>		
4	<i>Soil solution. Acidity and alkalinity of soils, their forms. Redox regime of soils. References: [5] p. 181-186; [8] p. 108-133</i>	2
<b>Section 5. Soil fertility</b>		
5	<i>Increasing soil fertility. The law of "declining fertility" and its critique. References: [8] p. 134-140</i>	2
<b>Section 6. Soil formation</b>		
6	<i>The role of soil fauna in soil formation. Biogenic structure formation. References: [8] p. 141-150 Thermal properties of soils. The role of the parent rock, terrain and terrain in soil formation. Anthropogenic factors of soil formation. References: [5] p. 229-234; [8] p. 151-162</i>	3
<b>Section 7. Biogeochemistry of soil formation</b>		
7	<i>Migration flows of elements. Geochemical barriers and reservoirs. References: [8] p. 164-176 Biogenic-accumulative, hydrogen-accumulative, metamorphic, eluvial and illuvial-accumulative soil-forming processes. References: [5] p. 74-85; [8] p. 183-190</i>	3
<b>Section 8. Systematics and classification of soils</b>		
8	<i>Types and subtypes of soils, genus and species and variety, category and subclass of soils. References: [6] p. 31-34; [8] p. 194-196 Soil-geographical zoning and general scheme of soil cover of Ukraine. References: [6] p. 29-31; [8] p. 201-204</i>	3
<b>Section 9. Soils of subboreal areas</b>		
9	<i>Saline soils, salt marshes, salt marshes. References: [6] p. 119-127; [8] p. 258-272</i>	2
<b>Section 10. Soil protection</b>		
10	<i>Violation of the bioenergetic regime of edaphotopes. Soil protection from devegetation and dehumidification. Soil fatigue, soil depletion and toxicosis. References: [6] p. 255-256; [8] p. 324-328 Protection of soils from overdrying. References: [8] p. 341-347</i>	3

	<i>Phytoindication of fertility and edaphic grid (for forest soils). Typification of fertility factors. Potential fertility. Effective fertility. Complete fertility. References: [6] p. 248-251</i>	
11	<i>Preparation for MCT from sections 1-10</i>	5
12	<i>Preparation for Test</i>	5
<i>Total hours</i>		36

## Politics and control

### 7. Policy of credit module

#### Rules for attending classes and behavior in classes

*Attending classes is a mandatory component of assessment. Graduate students are obliged to take an active part in the educational process, not to be late for classes and not to miss them without a good reason, not to interfere with the teacher to conduct classes, not to be distracted by actions that are not related to the educational process.*

#### Rules for assigning incentive and penalty points

- encouraging points can be credited by the teacher only for the performance of creative works in the credit module or additional passage of online specialized courses with the receipt of the appropriate certificate:*

*<https://www.coursary.com/course/introduction-to-building-better-soils-UZz094ab?fromfld=none>*

*<https://www.coursary.com/course/sustainable-soil-management-soil-for-life-qQT054c3?fromfld=none>*

*<https://www.coursary.com/course/soils-introducing-the-world-beneath-our-feet-wQT0e7f?fromfld=none>*

*However, their amount cannot exceed 10% of the rating scale.*

- penalty points within the credit module are not provided.*

#### Deadline and overlay policy

*In case of debts in the credit module or any force majeure circumstances, graduate students should contact the teacher through accessible (provided by the teacher) communication channels to solve problematic issues and coordinate the algorithm of actions for working out.*

#### Academic Integrity Policy

*Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the absence of references when using printed and electronic materials, quotes, opinions of other authors. Invalid hints and write-offs when writing tests, conducting classes; passing the credit for another graduate student; copying of materials protected by the copyright system without the permission of the author of the work.*

*The policies and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" <https://kpi.ua/code>.*

#### Policy of academic behavior and ethics

*Graduate students should be tolerant, respect the opinion of others, object to formulate in the correct form, constructively maintain feedback in the classroom.*

The norms of ethical behavior of students and employees are defined in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" <https://kpi.ua/code>.

## 8. Types of control and rating system for evaluating learning outcomes (RCOs)

Distribution of educational time by types of classes and tasks in the credit module according to the working curriculum:

Semester	School time		Distribution of training hours				Control measures		
	Loans	acad. H.	Lecture	Practical	Lab. Rob.	IWS	MCT	PP	Semester control
2	3	90	36	-	18	36	1	-	Test

**The student's rating in the credit module consists of points that he receives for:**

A student's credit module rating consists of the points he receives for laboratory work and for writing a module test.

Semester control is a test.

### System of rating (weight) points and evaluation criteria

Student rating from the credit module " **Geodynamics of the ecological environment. Part 1. Soil Science**" consists of points obtained for:

- 1) three tests (planned according to the work plan of the MTP is divided into 3 works lasting 30 minutes);
- 2) performance of 8 laboratory works.

1. Work in the laboratory.

Weight score - 5 for 8 laboratory works. The maximum number of points in all laboratory works is equal to: 5 points x 8 l / r = 40 points.

Criteria for assessing students' knowledge

Points	Completeness of the answer
5	Timely full implementation of l / r, calculations based on experimental data, design and protection of l / r
4	Minor shortcomings on the first point, untimely protection l / r
3-2	Untimely execution of l / r, shortcomings in calculations and issued l / r
0	Failure to perform l / r

2. Modular tests.

Weight score - 20. The maximum number of points for all tests is: 20 points x 3 work = 60 points

Criteria for evaluating tests

Points	Completeness of the answer
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<b>Points</b>	<b>Completeness of the answer</b>
19...20	Excellent", complete answer (at least 90% of the required information)
18...16	"Good", sufficiently complete answer (at least 75% of the required information or minor inaccuracies)
15...12	"Satisfactory", incomplete disclosure of the issue (at least 60% of the required information and minor errors)
11...1	unsatisfactory work (does not meet the requirements for "satisfactory")
0	lack of work

The calculation of points of control measures during the semester is:

$$R = 40 + 60 = 100 \text{ points.}$$

According to the results of educational work for the first 7 weeks, the "ideal student" must score 40 points. At the first attestation (8th week) the student receives "credited" if his current rating is not less than 20 points.

According to the results of educational work for 13 weeks of study, the "ideal student" must score 90 points. At the second attestation (14th week) the student receives "credited" if his current rating is not less than 45 points. A necessary condition for admission to the test is the delivery of all laboratory work and writing a modular test.

The maximum amount of points is 100. To receive credit from the credit module "automatic" you must have a rating of at least 60 points. Students who have a rating of less than 60 points at the end of the semester, as well as those who want to increase the score in the ECTS system, perform a test. The task of the test consists of 100 test questions from different sections of the work program of the credit module. Each question of control work is estimated in 1 point.

If the grade for the final test is lower than the rating, the applicant receives the higher of the marks obtained from the results of the final test or the rating.

The sum of points for control measures during the semester and for the final test work is transferred to the final grade according to the table.

<b>Score</b>	<b>Score</b>
95... 100	Perfectly
85... 94	very good
75...84	well
65... 74	Satisfactory
60...64	enough
RD < 60	Disappointing
Admission conditions not met	not allowed

## **9. Additional information from the credit module**

### **Questions to control works**

#### **Modular Control Test 1**

Option 1:

1. Definition of the concept of "soil", describe the stages of its formation.

2. Evaluate the concept of "morphological structure of the soil", describe the levels of morphological organization of the soil. Basic concepts of soil morphology.

3. What chemical elements predominate in the soil?

Option 2:

1. Identify the place and role of soil in nature and human activities. What is the importance of soil science for biology, agriculture and physical and economic geography?

2. Define the concept of "soil profile", the reasons for its formation.

3. What is the similarity and difference of soils and rocks in chemical composition?

Option 3:

1. Name the main methodological principles of genetic soil science.

2. Define the concept of "particle size fractions", give a brief description.

3. Describe the sources of humus in the soil.

Option 4:

1. Evaluate the color as an important morphological feature of the soil.

2. Compare different types of weathering of rocks.

3. Define the concept of "soil colloids", describe their material composition, the structure of colloidal micelles.

Option 5:

1. What minerals are called secondary and what is their role in soil formation and formation of soil properties?

2. Describe the general physical properties of the solid phase of soils.

3. Define the concept of "soil absorption complex", describe its main characteristics.

### **Modular Control Test 2**

Option 1:

1. Evaluate the concept of "soil moisture", compare the possible conditions of water in the soil.

2. Give a comparative description of the influence of different groups of plant formations on the process of soil formation.

3. Summarize the patterns of migration of substances on the earth's surface.

Option 2:

1. Describe the forms and basic properties of liquid groundwater.

2. What are the main functions of microorganisms in soil formation and formation of soil fertility?

3. Describe the features of the small biological cycle of substances in nature.

Option 3:

1. Define the concept of "soil solution", describe its composition and properties.

2. List the main groups of animals involved in soil formation and describe their role in this process.

3. Describe the biogenic-accumulative elementary soil processes.

Option 4:

1. Describe the different types of soil acidity, the causes of their occurrence and methods of combating it.

2. Assess the impact of climate on soil formation.

3. Describe the hydrogen-accumulative elementary soil processes.

Option 5:

1. Give a general description of ground air.

2. Assess the impact of age and economic activity on soil formation.

3. Describe the metamorphic elementary soil processes.

### **Modular Control Test 3**

#### *Option 1:*

- 1. Define the concept of "soil classification".*
- 2. Describe the conditions of soil formation and soil cover of subboreal forest areas.*
- 3. Describe the mechanism of soil desertification.*

#### *Option 2:*

- 1. Describe the basic patterns of soil placement on the earth's surface.*
- 2. Describe the composition and properties of brown forest soils.*
- 3. Determine the negative impact of mudslides and landslides on the planet's soil.*

#### *Option 3:*

- 1. Describe the principles of soil-geographical zoning of land.*
- 2. What are the main features of chernozem formation?*
- 3. Justify the protection of soils from over-drying.*

#### *Option 4:*

- 1. What soil and bioclimatic zones are distinguished on the globe?*
- 2. What are the main reasons for the formation of saline soils?*
- 3. Describe the negative impact of overcompaction on the functioning of edaphotopes.*

#### *Option 5:*

- 1. Briefly describe the features of soil-geographical zoning of Ukraine.*
- 2. Describe the chernozems of the Steppe.*
- 3. Identify the relationship between soil pathology and human health.*

### **Test questions**

#### **Control questions to section 1**

- 1. Definition of the concept of "soil", describe the stages of its formation.*
- 2. Determine the place of soil in terrestrial ecosystems.*
- 3. Describe soil science as a science, its main provisions.*
- 4. Justify the connection of soil science with other sciences and name the main sections of soil science.*
- 5. Give a brief description of the main stages of development of soil science.*
- 6. Give a comparative description of the main methods of studying the soil.*
- 7. Name the main methodological principles of genetic soil science.*
- 8. Name the main research methods used in soil science.*
- 9. Determine the place and role of soil in nature and human activities. What is the importance of soil science for biology, agriculture and physical and economic geography?*
- 10. Justify the concept of "soil - a mirror of the landscape."*
- 11. Why soil is the main means of production in agriculture?*

#### **Control questions to section 2**

- 1. Give a brief description of the phase composition of the soil.*
- 2. Evaluate the concept of "morphological structure of the soil", describe the levels of morphological organization of the soil. Basic concepts of soil morphology.*
- 3. Define the concept of "soil profile", the reasons for its formation.*
- 4. Describe the main types of structure of profiles and boundaries between genetic horizons.*



5. Define the concept of "genetic horizons", describe the basic principles and directions of their indexation.
6. Evaluate the color as an important morphological feature of the soil.
7. Evaluate the structure of the soil as an important morphological feature.
8. Define the concept of "particle size fractions", give a brief description.
9. Define the concept of "particle size distribution of soils", the principles of classification of soils by particle size distribution.
10. Give the classification and characterization of the properties of mechanical elements of soils.
11. How does the particle size distribution of rocks affect soil formation?
12. How does the particle size distribution of soils affect their properties?
13. Evaluate neoplasms and inclusions as an important morphological feature of the soil.
14. Describe the principles of Ukrainian indexation of genetic horizons.
15. Describe the diagnostic features of surface genetic horizons.
16. Describe the diagnostic signs of superficial genetic horizons.
17. Justify the advantages and disadvantages of Ukrainian indexing of genetic horizons.
18. Evaluate the nature of the transitions between genetic horizons as a morphological feature.
19. Describe the main primary minerals of rocks and soils.
20. Compare different types of weathering of rocks.
21. What minerals are called secondary and what is their role in soil formation and formation of soil properties?
22. Give a comparative description of the main soil-forming (parent) rocks.
23. What is the mineralogical composition of sedimentary rocks compared to magmatic?
24. Describe the general physical properties of the solid phase of soils.
25. Identify the cause of physical degradation of soils in Ukraine and justify ways to combat this negative phenomenon.

### **Control questions to section 3**

1. What is the similarity and difference of soils and rocks in chemical composition?
2. What chemical elements predominate in the soil?
3. How does the chemical composition of rocks and soils affect soil formation?
4. Compare the carbon content of soils and lithosphere and determine the cause of the discrepancy.
5. Describe the main trace elements found in soils, their importance for plant nutrition.
6. Name the main groups of organic matter in the soil.
7. Describe the sources of humus in the soil.
8. Briefly describe the processes of conversion of organic residues into humus.
9. Compare the characteristics of the components of soil humus.
10. Describe the organo-mineral compounds of the soil.
11. Define the concept of "group and fractional composition of humus".
12. Describe the role of humus in soils and ways to regulate its content.
13. Describe the geographical patterns of distribution of humic substances in soils.
14. Describe the ecological significance of humus.
15. Define the concept of "soil colloids", describe their material composition, the structure of colloidal micelles.
16. Describe the main properties of soil colloids.

17. Describe the possible physical states of soil colloids, ways of transition from one state to another (peptization and coagulation).
18. The concept of soil absorption capacity, its types.
19. Define the concept of "soil absorption complex", describe its main characteristics.
20. Justify the ecological significance of soil absorption capacity.

#### **Control questions to section 4**

1. Evaluate the concept of "soil moisture", compare the possible conditions of water in the soil.
2. Describe the forms and basic properties of liquid groundwater.
3. Describe the gravitational water, compare the main types of groundwater.
4. Describe the soil - hydraulic constants and explain how they are used in practice.
5. Compare the main types of soil moisture, the concept of permeability.
6. Evaluate the availability of different categories of soil moisture to plants.
7. Define the concept of "soil solution", describe its composition and properties.
8. Describe the different types of soil acidity, the causes of their occurrence and methods of combating it.
9. Describe the alkalinity of soils and ways to regulate them.
10. Define the concept of "soil buffering".
11. The concept of redox regime of soils, its indicators.
12. Give a general description of ground air.
13. Analyze the basic air and physical properties of soils.
14. Analyze the difference in the composition of atmospheric and ground air.

#### **Control questions to section 5**

1. Analyze the history of the doctrine of soil fertility.
2. Briefly describe the history of the development of views on the essence of soil fertility.
3. Define soil fertility, critically analyze the law of "declining soil fertility".
4. Justify the selection of categories of soil fertility.
5. Describe the factors of natural soil fertility.
6. Explain why the soil is cultivated.

#### **Control questions to section 6**

1. The concept of factors and conditions of soil formation.
2. What is plant formation, what indicators characterize vegetation as a factor of soil formation?
3. Give a comparative description of the influence of different groups of plant formations on the process of soil formation.
4. Justify the role of algae and lichens in the formation of "mobile" rock.
5. What are the main functions of microorganisms in soil formation and formation of soil fertility?
6. List the main groups of animals involved in soil formation and describe their role in this process.
7. Assess the impact of climate on soil formation.
8. Compare different types of water regime of soils.
9. Name the grouping and give a description of the climate in terms of temperature, humidity.
10. Describe the thermal properties and thermal regimes of soils.
11. What is the role in soil formation of parent rocks and relief?
12. Assess the impact of age and economic activity on soil formation.

### **Control questions to section 7**

1. Describe the basic laws of biogeochemistry of soil formation.
2. Give a brief description of the large geological cycle of substances in nature.
3. Compare different types of weathered bark.
4. Describe the features of the small biological cycle of substances in nature.
5. Define the concept of intensity and capacity of the cycle of elements, describe their cycles.
6. Generalize the patterns of migration of substances on the earth's surface.
7. Generalize the patterns of accumulation of substances on the earth's surface.
8. Describe the general scheme of soil formation on the globe. What is the primary process of soil formation?
9. Describe the biogenic-accumulative elementary soil processes.
10. Describe the hydrogen-accumulative elementary soil processes.
11. Describe the metamorphic elementary soil processes.
12. Describe the illuvial and eluvial elementary soil processes.
13. Describe pedoturbation and destructive elementary soil processes.
14. The concept of type of soil formation, examples.

### **Control questions to section 8**

1. Define the concept of "soil classification", give a description of the type as the main reference fee of the hoe unit in the classification.
2. Define taxonomic units of soil classification below the type.
3. Describe the basic patterns of soil placement on the earth's surface.
4. Describe the principles of soil-geographical zoning of land.
5. Describe the basic units of soil-geographical zoning.
6. What soil-bioclimatic zones are distinguished on the globe?
7. Briefly describe the features of soil-geographical zoning of Ukraine.

### **Control questions to section 9**

1. Describe the conditions of soil formation and soil cover of subboreal forest areas.
2. Indicate the main processes that form the profile of brown forest soils.
3. Describe the composition and properties of brown forest soils.
4. Describe the conditions of soil formation and soil cover of the forest-steppe zone of the subboreal zone.
5. Describe the processes that form the profile of gray forest soils?
6. Name the subtypes, genera and species of gray forest soils and analyze the indicators of their diagnosis.
7. Give a comparative description of the properties of subtypes of gray forest soils.
8. Specify methods to increase the fertility of gray forest soils.
9. What are the main features of chernozem formation?
10. Describe the chernozems of the Forest-Steppe.
11. Analyze the conditions of soil formation and soil cover of the steppe zone of the subboreal belt.
12. Describe the chernozems of the Steppe.
13. What are the main problems of use and protection of chernozems?

14. Analyze the conditions of soil formation and soil cover of the dry steppe zone of the subboreal belt.
15. Describe the features of the genesis and properties of chestnut soils.
16. What are the main reasons for the formation of saline soils?
17. Describe saline soils as a type of introzonal soils.
18. What is the essence of the solonetzic process of soil formation?
19. Describe salt marshes as a type of introzonal soils.
20. Describe malt as a type of introzonal soil.
21. Compare measures to increase the fertility of salt marshes, salt marshes and malts. Identify ways of scientifically sound use of these soils.

### **Control questions to section 10**

1. Define the task of soil protection.
2. Analyze the protection of soils from erosion and deflation
3. Describe the negative impact of overcompaction on the functioning of edafops.
4. Analyze the violation of the bioenergy regime of soils and ecosystems.
5. Describe the mechanism of soil desertification.
6. Determine the negative impact of villages and landslides on the soil cover of the planet.
7. Analyze the protection of edaphotopes from the processes of secondary salinization, salinization and lithization.
8. Identify the factors of secondary acidity of soils.
9. Justify the protection of soils from overdrying.
10. Analyze the protection of edaphotopes from contamination by agrochemicals.
11. Analyze the protection of edaphotopes from the influence of products of technogenesis.
12. Identify the relationship between soil pathology and human health.
13. Describe soil monitoring.

### **Work program of the credit module (syllabus):**

**Compiled** by Doctor of Technical Sciences, Associate Professor O.I. Ivanenko

**Approved** by the Department \_\_\_ E and TRP \_\_\_ (protocol № 14 from 8.06.2022)

**Approved** by the Methodical Commission of ICF (protocol № \_10\_ from \_24.06.2022)