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|  | COURSE SYLLABUS « Soil Science with Basics of Geology » |
| | Degree of higher education - Bachelor |
| | Specialization: 201 Agronomy |
| | Educational programme: “Agronomy ” |
| | Academic year: 1,2 semesters: 2, 3 |
| | Form of study: full-time |
| | Number of ECTS credits: 7 |
| | Language of instruction: English |
| Lecturer of the course | Yuriy Kravchenko, PhD, Associate Professor |
| Contact information of the lecturer (e-mail) | Soil Science & Soil Conservation Department, build. № 2, room. 23, yukravch@i.ua |
| Course page on eLearn | https://elearn.nubip.edu.ua/course/view.php?id=2700 |

COURSE DESCRIPTION

This course is an introductory designed course for the Bachelor student, which provides the basic concepts of all aspects of geology and soil science. It encompasses: Earth’s origin; internal and external Earth’s dynamics; minerals and rocks – formation, composition, diagnostics and properties changes; agronomic ores properties and application; anthropogenic influence on geologic environment. The course presents the soil composition and genesis; physical, chemical, and biological properties; soil water; classification and mapping; soil conservation; management practices; and soil fertility and productivity (soil testing, use of fertilizers and liming), soil quality assessment. The course gives practical experience as an aid in developing understanding of the minerals, rocks and soils as natural bodies, the use of which has an influence on environmental, human society and life in general.

Competencies of the educational programme:

Integrated competency (IC):

- the ability to solve difficult specialized tasks and practical problems in agronomy, including the application of theories and methods of the relevant science and is characterized by the complexity and uncertainty of conditions.

General Competencies (GC):

- GC 3 - ability to abstract thinking, analysis and synthesis;
- GC 5 - ability to use foreign language;
- GC 6 - knowledge and understanding of the subject area and understanding of the professional activity;
- GC 7 - ability to apply knowledge in practical situations;
- GC 11 - striving to sustain the environmental.

Professional (special) competencies (PC):

- PC 1 – ability to use the basic knowledge of general subdivisions of agrarian sciences (plant growing, farming, plant selection and seed science, agricultural chemistry, horticulture, soil science, fodder production, agrotechniques in plant growing, plant protection);
- PC 5 – ability to estimate, interpret and synthesize the theoretical and practical information as well as industrial and research data in agriculture production;
- PC 9 - ability to provide complex management of activities and projects, responsibility for decision making under industrial conditions.

Program learning outcomes (PLO) of the educational programme:

- to compare and evaluate modern scientific and technical achievements in the field of agronomy;
- to conduct a literature search in Ukrainian and foreign languages and analyze the received information;
- to demonstrate the knowledge and understanding of fundamental disciplines to the extent necessary to possess relevant skills in the field of agronomy;
- to provide at the operational level the methods of: observation, description, identification, classification, as well as the cultivation of the objects and maintain the stability of agrocenoses with the conservation of natural diversity.

COURSE STRUCTURE

| Topic | Hrs lec/ lab | Learning outcomes | Tasks | Asses sm. |
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| Semester 2 | | | | |
| Module 1 | | | | |
| Topic 1. 1.Introduction to course. What is soil? | 2/2 | <i>Know:</i> soil key concepts. <i>Be able to:</i> determine functions of soil. <i>Analyze:</i> soil phases. <i>Understand:</i> importance of soil. <i>Use:</i> knowledge about soil components in soil testing. | Submitting lab work №1 | 8 |
| Topic 2. Internal and external spheres. | 2/4 | <i>Know:</i> The Earth's internal and external spheres. <i>Be able to:</i> describe the Earth's internal and external structure. <i>Analyze:</i> The Earth's spheres properties. <i>Understand:</i> minerals' structure and physical properties. <i>Use:</i> to describe a soil mineral composition. | Submitting lab work №2 | 6 |
| Topic 3. Magmatic, metamorphic and sedimentary processes. | 2/2 | <i>Know:</i> magmatic, metamorphic and sedimentary processes. <i>Be able to:</i> provide a lab testing of minerals. <i>Analyze:</i> internal and external processes. <i>Understand:</i> internal and external dynamics. <i>Use:</i> to describe the Earth geological structures, rocks and minerals. | Submitting lab work №3 | 6 |
| Topic 4. Endogenic geological processes. | 2/2 | <i>Know:</i> plate tectonics, volcanoes, earthquakes. <i>Be able to:</i> distinguish deformations, estimate causes of volcanoes and earthquakes. <i>Analyze:</i> types of endogenic processes. <i>Understand:</i> role of endogenic processes in relief formation. <i>Use:</i> in soil genesis. | Submitting lab work №4 | 6 |
| Topic 5. Weathering processes and soil formation | 2/2 | <i>Know:</i> about weathering. <i>Be able to:</i> define the factors that control rates of chemical and mechanical weathering. <i>Analyze:</i> the driving forces of weathering. <i>Understand:</i> mechanical, chemical and biological weathering. <i>Use:</i> weathering knowledge in a description of soil genesis. | Submitting lab work №5 Completing self-work 1.1. | 6 10 |
| Topic 6. Exogenic geological processes. | 2/2 | <i>Know:</i> exogenic activity. <i>Be able to:</i> describe a movement of solid particles on slopes. <i>Analyze:</i> eolian, stream, slope, lake and marine deposits. <i>Understand:</i> wind and rill erosion. <i>Use:</i> at studying of soil parent materials. | Submitting lab work №6 Taking mid-term exam 1 | 8 50 |
| Total for Module 1 | | | | 100 |
| Module 2 | | | | |
| Topic 7. Soil formation and soil processes | 2/2 | <i>Know:</i> Soil formation and soil genesis. <i>Be able to:</i> describe passive and active soil forming factors. <i>Analyze:</i> soil forming processes. <i>Understand:</i> fundamental soil forming processes. <i>Use:</i> knowledge about soil forming factors and processes to fill out the form of a soil profile description | Submitting lab work № 7 | 4 |
| Topic 8. Soil classification. | 2/2 | <i>Know:</i> different approaches in soil classifications. <i>Be able to:</i> name the soil on the principles of Ukrainian classification. <i>Analyze:</i> FAO nomenclature of soils. <i>Understand:</i> principles of soil classifications. <i>Use:</i> soil classifications to name a soil. | Submitting lab work № 8 | 5 |
| Topic 9. Soil taxonomy and morphology. | 2/2 | <i>Know:</i> soil taxonomy. <i>Be able to:</i> classify soils based on soil taxonomy principles. <i>Analyze:</i> FAO, WRB, Ukrainian taxonomy systems. <i>Understand:</i> genetic principles of Ukrainian taxonomy system. <i>Use:</i> Morphological features in a soil profile description. | Submitting lab work № 9 | 4 |

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| Topic 10. Overview of soil properties and ecosystem functions | 2/2 | <i>Know:</i> ecological functions of soil. <i>Be able to:</i> classify soil properties. <i>Analyze:</i> soil parameters. <i>Understand:</i> availability of nutrients. <i>Use:</i> in ecological monitoring. | Submitting lab work №10 | 4 |
| Topic 11. Soil physical properties 1. Texture, structure and soil water categories | 2/4 | <i>Know:</i> the soil solid components. <i>Be able to:</i> provide a lab experiment for soil particles analysis. <i>Analyze:</i> particle sizes and soil texture. <i>Understand:</i> soil properties based on its particle composition. <i>Use:</i> a soil texture data in agronomy and land management. | Submitting lab work № 11 | 5 |
| Topic 12. Soil ecology 1. Soil communities, plants, macro- and microanimals | 2/2 | <i>Know:</i> soil ecology. <i>Be able to:</i> estimate structurally and chemically diverse of natural organic resources. <i>Analyze:</i> soil living organisms. <i>Understand:</i> the role of organic matter in soil function. <i>Use:</i> different technologies to accumulate soil organic resources. | Submitting lab work № 12 | 4 |
| Topic 13. Soil ecology 2. Fungi, bacteria and archaea, microbial interactions | 2/2 | <i>Know:</i> soil microbiology. <i>Be able to:</i> estimate the dynamics of soil biota in arable and virgin ecosystems. <i>Analyze:</i> different classes of microorganisms. <i>Understand:</i> the role of microorganisms in SOM accumulation. <i>Use:</i> to develop the approaches to support a soil healthy. | Submitting lab work № 13 | 4 |
| Topic 14. Soil organic matter 1. | 2/2 | <i>Know:</i> soil organic matter composition. <i>Be able to:</i> estimate the quantity of a soil organic matter. <i>Analyze:</i> a soil organic matter in a lab. <i>Understand:</i> a soil organic matter quality. <i>Use:</i> agricultural practices to maintain of humus quantity and quality | Submitting lab work № 14 Completing self-work 2.1. | 5 10 |
| Topic 15. Soil organic matter 2. | 2/2 | <i>Know:</i> ways of SOM inputs and outputs. <i>Be able to:</i> calculate the SOM balance. <i>Analyze:</i> the agriculture effect on SOM content. <i>Understand:</i> the role of soil organic matter in a soil fertility. <i>Use:</i> at development of a modern agricultural practices. | Submitting lab work № 15 Taking mid-term exam 2 | 5 50 |
| Total for Module 2 | | | | 100 |
| Total for 2st semester ((100+100)/2) x 0,7 | | | | 70 |
| Exam of 2st semester | | | | 30 |
| Total for 2st semester course | | | | 100 |
| Semester 3 | | | | |
| Module 3 | | | | |
| Topic 16. Soil colloids. | 2/2 | <i>Know:</i> origin and compositing of soil colloids. <i>Be able to:</i> outline types of soil colloids. <i>Analyze:</i> properties of soil colloids. <i>Understand:</i> role of soil colloids in soil genesis and soil productivity. <i>Use:</i> colloidal matter to increase a soil adsorbing capacity. | Submitting lab work № 16 | 5 |
| Topic 17. Sorption, cation and anion exchange. | 2/2 | <i>Know:</i> types and practical significance of soil absorbing capacity. <i>Be able to:</i> estimate CEC & composition of exchangeable cations. <i>Analyze:</i> cation exchange capacity. <i>Understand:</i> cation and anion composition influence on soil colloids. <i>Use:</i> agricultural practices to manage soil cation and anion composition. | Submitting lab work № 17 | 5 |
| Topic 18. Soil acidity and alkalinity. | 2/2 | <i>Know:</i> about soil acidity and alkalinity. <i>Be able to:</i> manage soil acidity and alkalinity. <i>Analyze:</i> soil acidity and alkalinity in a lab. <i>Understand:</i> the reasons of soil acidity and alkalinity. | Submitting lab work № 18 | 5 |

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| | | <i>Use:</i> lime and gypsum application to manage soil acidity and alkalinity. | | |
| Topic 19. Soil salinity. | 2/2 | <i>Know:</i> about soil salinity. <i>Be able to:</i> manage soil salinity. <i>Analyze:</i> soil soluble salts by a water extract analysis. <i>Understand:</i> the genesis of soil salinity. <i>Use:</i> leaching rates to maintain soil salinity. | Submitting lab work № 19 | 5 |
| Topic 20. Soil physical properties 2. Soil structure, soil density, pore space, impacts of tillage. | 2/2 | <i>Know:</i> soil structure and its types. <i>Be able to:</i> evaluate in the field: soil structure, soil particle and bulk density, soil porosity. <i>Analyze:</i> soil particle and bulk density, soil porosity. <i>Understand:</i> soil physical properties. <i>Use:</i> soil mechanical properties knowledge for soil tillage management. | Submitting lab work № 20 | 5 |
| Topic 21. Soil water. | 2/2 | <i>Know:</i> water origin, properties and structure. <i>Be able to:</i> define forms (categories) of soil water. <i>Analyze:</i> plant and soil water relations (soil moisture constants). <i>Understand:</i> energy concepts of soil water. <i>Use:</i> different methods of soil water potential expression | Submitting lab work № 21 | 5 |
| Topic 22. Soil air and temperature | 2/2 | <i>Know:</i> soil air and temperature. <i>Be able to:</i> regulate soil air and temperature conditions. <i>Analyze:</i> soil air/temperature & modes of energy transfer. <i>Understand:</i> plant requirements to soil air and temperature conditions. <i>Use:</i> agricultural practices to manage soil air and temperature regimes. | Submitting lab work № 22 Completing self-work 3.1. | 5 10 |
| Topic 23. Soil productivity and its evaluation. | 2/2 | <i>Know:</i> soil productivity and its evaluation. <i>Be able to:</i> to evaluate soil productivity by a A.I.Siry method. <i>Analyze:</i> soil properties by 0 to 100-point scale. <i>Understand:</i> role of a soil productivity in crop yields. <i>Use:</i> a land suitability class to land management. | Submitting lab work № 23 Taking mid-term exam 3 | 5 50 |
| Total for Module 3 | | | | 100 |
| Module 4 | | | | |
| Topic 24. Soils of the Forest Zone of Ukraine. | 2/2 | <i>Know:</i> natural conditions of the Forest Zone of Ukraine. <i>Be able to:</i> describe a profile of the Forest soils of Ukraine. <i>Analyze:</i> properties of the Forest Zone soils of Ukraine. <i>Understand:</i> the fertility management of the Forest Zone soils of Ukraine. <i>Use:</i> in agriculture the Forest Zone soils of Ukraine. | Submitting lab work № 24 | 6 |
| Topic 25. Soils of the Forest-Steppe zone of Ukraine. | 2/2 | <i>Know:</i> natural conditions of the Forest-Steppe Zone of Ukraine. <i>Be able to:</i> describe a profile of the Forest-Steppe soils of Ukraine. <i>Analyze:</i> properties of the Forest-Steppe soils of Ukraine. <i>Understand:</i> the fertility management of the Forest-Steppe Zone soils of Ukraine. <i>Use:</i> in agriculture the Forest-Steppe Zone soils of Ukraine. | Submitting lab work № 25 | 6 |
| Topic 26. Soils of the Steppe zone of Ukraine. | 2/2 | <i>Know:</i> natural conditions of the Steppe Zone of Ukraine. <i>Be able to:</i> describe a profile of the Steppe soils of Ukraine. <i>Analyze:</i> properties of the Steppe soils of Ukraine. <i>Understand:</i> the fertility management of the Steppe Zone soils of Ukraine. <i>Use:</i> in agriculture the Steppe Zone soils of Ukraine. | Submitting lab work № 26 | 6 |
| Topic 27. Soils of the Arid-Steppe zone of Ukraine. | 2/2 | <i>Know:</i> natural conditions of the Arid Steppe Zone of Ukraine. <i>Be able to:</i> describe a profile of the Arid Steppe soils of Ukraine. <i>Analyze:</i> properties of the Arid Steppe soils of Ukraine. <i>Understand:</i> the fertility management of the Arid Steppe Zone soils of Ukraine. <i>Use:</i> in agriculture the Arid Steppe Zone soils of Ukraine. | Submitting lab work № 27 | 6 |

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| Topic 28. Saline soils. | 2/2 | <i>Know:</i> natural conditions of the saline soils' formation. <i>Be able to:</i> describe a profile of the saline soils. <i>Analyze:</i> properties of the saline soils. <i>Understand:</i> the fertility level of the saline soils. <i>Use:</i> in agriculture the saline soils. | Submitting lab work № 28 | 6 |
| Topic 29. Alluvial and Meadow Soils. | 2/2 | <i>Know:</i> natural conditions of the flooding plain soils' formation. <i>Be able to:</i> describe a profile of the flooding plain soils. <i>Analyze:</i> properties of the flooding plain soils. <i>Understand:</i> the fertility management of the flooding plain soils. <i>Use:</i> in agriculture the flooding plain soils. | Submitting lab work № 29 Completing self-work 4.1. | 6 10 |
| Topic 30. Soil erosion, degradation and productivity management | 2/2 | <i>Know:</i> types of soil degradation. <i>Be able to:</i> predict a soil erosion. <i>Analyze:</i> factors influencing soil erosion and degradation. <i>Understand:</i> soil conservational management. <i>Use:</i> in a recovering agriculture. | Submitting lab work № 30 Taking mid-term exam 4 | 4 50 |
| Total for Module 4 | | | | 100 |
| Total for 3nd semester ((100+100)/2) x 0,7 | | | | 70 |
| Exam of 3nd semester | | | | 30 |
| Total for 3nd semester course | | | | 100 |

ASSESSMENT POLICY

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| <i>Policy regarding deadlines and results:</i> | Students are required to take all two mid-term exams and the final exam in this course. Lab reports are submitted on elearn platform. Lab reports submitted after due date will be assessed at a penalty of 10% of the total lab report point value for each 24-hour period beyond the due date. Make-up lab submitting will only be provided for students with excused absences. Students are expected to submit four self-works prior a session. |
| <i>Academic honesty policy:</i> | Copying of others' work, use of disallowed material on exams, plagiarism in assignments, or cheating in any other form as defined by the instructor will result in a grade of zero for that assignment. Multiple infractions will result in a grade of 'F' for the course. No electronic equipment, except calculators, will be allowed during exams. |
| <i>Attendance Policy:</i> | Students are expected to be present at all lectures and to arrive on time. If a student must miss a lecture, her/his is responsible for all material presented during lecture and for the assigned textbook reading. Excused absences will only be granted for documented academic conflicts, international staging, documented medical reasons and force majeure. Students are expected to respect the rights of others in the class. Cell phones and other electronic equipment should be turned off prior to the beginning of class. |

SCALE OF ASSESSMENT OF STUDENT KNOWLEDGE

| Student's 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 |

RECOMMENDED SOURCES OF INFORMATION

1. Kravchenko Y.S. Geology with the principles of Geomorphology. Part 1. Dynamic Geology. Київ, ТОВ "Центр ІТ". 2009. 142 с.
2. Petrenko L., Berezhniak M., Kravchenko Y., Kozak V., Berezhniak E. Fundamentals of soil science. Kyiv, K.: ЦП "Komprint", 2020. 702 p
3. Carlson D.H., Plummer C.C., Hammersley L. Physical Geology. McGraw-Hill, 2015. 672 p.
4. Petrenko L., Berezhniak M., Kravchenko Yu., Tonkha O., Berezhniak Ie., Bykova O. Soil Science : Practical Methods Manual. – NUBIPU Publishing Center, Kyiv, 2013. 429 pp.
5. Internet sources. Електронні курси:
 - <https://elearn.nubip.edu.ua/course/view.php?id=2702>.
 - <https://elearn.nubip.edu.ua/course/view.php?id=3304>.