COURSE SYLLABUS
«INORGANIC AND ANALYTICAL CHEMISTRY»

Degree of higher education - Bachelor
Specialization 202 Plant protection and Quarantine
Educational programme «202 Plant protection and Quarantine»
Academic year __1___, semester 1_
Form of study _____ full-time _(full-time)
Number of ECTS credits_4___
Language of instruction ___ English _(Ukrainian, English, German)

Lecturer of the course	**Ph. D. Lavrik Ruslan**
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Course page on eLearn	**https://elearn.nubip.edu.ua/course/view.php?id=1185**

COURSE DESCRIPTION

(up to 1000 printed characters)

Inorganic and Analytical Chemistry is a fundamental discipline, obligatory for teaching students received the specialties in the field of Plant protection and Quarantine of Higher Educational Agrarian Universities of III-IV accreditation levels. This program was developed on the base of Educational Program of Subject "Inorganic and Analytical Chemistry" for specialty (field) "Plant protection and Quarantine".

In modern society Inorganic and Analytical Chemistry is powerful source of productive powers. In particular, intensification of scientific and technological progress in agricultural and food production requires a rational use of chemical science achievement, intensification of ecological monitoring of economic activity.

So, the main goal of presented discipline is the study of properties, preparation methods and use of chemical elements and their compounds, acquiring the skills for execution.

The main objectives of Inorganic chemistry are:

- Study the bases for subjects as the part of fundamental training for specialties in the field of Agronomy;
- Creation of a scientific basis for study of professional-oriented and special subjects (Organic Chemistry, Biochemistry, Phytopathology, etc.);
- Assimilation of general ideas of chemical experiments using semi-micromethod.

In the result of study the student should:

To know: the classification of inorganic substances and ideas about genetic relationships between them; modern ideas on atomic structure and molecules; nature and characteristics of chemical bonds; general laws of chemical kinetics and chemical equilibrium; nature of solution formation and processes in solutions (electrolytic dissociation, hydrolysis); basic ideas of RedOx processes; nature, structure, chemical properties of coordination (complex) compounds: structure of electronic shells, chemical properties, methods of isolation, biogeochemical functions, using in human life and, in particular, in agricultural production, macro-, micronutrients, and toxic chemical elements and their compounds; chemical models of biological processes; to receive the knowledge about classical and modern methods of chemical analyses, formation of skills of chemical analysis using the modeling objects, which will be increased on the real objects of Plant protection and Quarantine fields (plants, fertilizers, water, pesticides, foods etc.):

Competencies of the educational programme:

*Integrative competency (IC):Ability to solve complex specialized problemsand practical problems of professional activity with protection and quarantine of plants and apply theoretical knowledge and methods of phytosanitary monitoring, review, analysis, expertise, which are characterized complexity and uncertainty of conditions*_____

General competencies (GC):

1. Ability to abstract thinking, analysis andsynthesis

*2. Ability to apply knowledge in practicalsituations*_____

*Professional (special) competencies (PC):*_____

Program learning outcomes (PLO) of the educational programme: _____

_____*4_ Have knowledge of the fundamental sections of higher mathematics, biophysics, chemistry (analytical, organic, inorganic, physical and colloid), botany andagrozoology to the extent necessary for understanding the processes of the specialty protection and plant quarantine*

COURSE STRUCTURE

Topic	Hours (lecture/laboratory, practical/ self)	Learning outcomes	Tasks	Assessment
1 semestr				
Модуль 1				
Theme 1. Introduction. General laws of stoichiometry and types of chemical reactions.	2/4/	Define that one mole of a substance contains the same number of particles (N_A) as the atoms in 12 grams of carbon-12. Explain the conversion between number of particles to number of moles. Calculate Molar Mass using atomic mass. Use the formula: m = n·M or mass (g) = number of moles · molar mass ($g\ mol^{-1}$). Explain that one mole of gas has always the same volume at temperature and pressure given Use the formula: $V = n \cdot V_m$	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 2. Atomic structure of chemical elements.	4/2/	Understand the historic development of atomic models, from Democritus to Bohr. Construct and use graphic descriptions of an atom consisting of protons, electrons and neutrons. Recognize that the number of protons defines the elements. Write the notations for the atomic (or charge) number (Z) and mass number (A).	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical

		Apply the notation of an element: $^{A}_{Z}X$ Recognize that isotopes of the same element have different masses. Explain that the relative atomic mass of an element depends on the relative abundance of its isotopes.		competence need open questions or other ways of assessing.
Theme 3. The Periodic Law and Periodic Table of chemical elements.	3/5/	Arrange elements according to their atomic number. Understand that electron arrangement in an atom is related to its position in the periodic table and that number of electron shells is determined by period number or name of shells: K, L,M,N… Draw Lewis representation of atoms. Explain reactivity of elements as a consequence of the electron arrangement in the outer shell; Recall the name and location of the following groups in the periodic table: alkali metals, alkaline-earth metals, halogens and noble gases Group elements according to physical and chemical properties; Connect properties of elements to their position in the periodic table.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 4. Chemical	2/4/	Use the octet rule to explain the	Perform in-class labs and provide	Assessing content

bonding and structure of molecules.		formation of ions and covalent bond formation. Understand that ionic bond is the electrostatic attraction between ions of opposite charge; Ability to describe and illustrate ionic lattice using for instance NaCl as a model; Being able to explain that ionic compound formula shows the ratio of positive and negative ions; Describe the properties of compounds formed by ionic bonds: e.g. melting point, solubility, and conductivity of electricity. Being able to draw a schematic representation of a covalent bond, showing one or more pairs of electrons between the atoms. Give examples of molecules formed through covalent bond(s);	data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 5. Chemical kinetics and equilibrium.	2/0/	Describe a chemical reaction in terms of energy and mass conservation; Discuss and explain activation energy as the process of breaking and forming bonds; Explain the difference between an exothermic and an endothermic reaction. Discuss and being able to predict how	Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in

		the factors (concentration, temperature and active surface) affect the rate of reaction. Explain that a catalyst lowers the activation energy of a reaction.		argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 6. Solutions, their nature and properties.	3/2/	Define what a solution is. Illustrate the different properties (conductivity) between molecular and ionic solutions. Define concentration (mass/volume).	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 7. Electrolytes and reactions in their solutions.	3/4/	Define acids, and bases and salts in terms of Electrolytic dissociation. Describe the meaning of weak and strong electrolytes. Write the dissociation reactions in molecular, ionic and net-ionic form.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as

				communication and chemical competence need open questions or other ways of assessing.
Theme 8. Hydrolysis of salts.	4/4/	Explain the pH-scale as a measure of the concentration of H^+ ions in aqueous solutions. Link pH with the acidic, neutral or basic properties of aqueous solutions. Use acid/base indicators, universal indicator (liquid or paper) and pH meter to determine the pH of aqueous solutions. Explain the impact of dilution on the pH-values. Write the hydrolysis reactions in molecular, ionic and net-ionic form.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 9. Coordination compounds.	2/4/	Identify properties and characteristics of coordination compounds such as oxidation number, coordination number, and so on. Give proper naming and chemical formula of coordination compounds. Identify the structure of coordination compounds based on their coordination numbers. Determine isomers (both optical and structural) of	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence

		coordination compounds.		need open questions or other ways of assessing.
Theme 10. Redox reactions.	3/4/	Define redox reactions as the loss and gain of electrons. Illustrate the redox reaction as the exchange of electrons at atomic level. Define oxidation as a loss of electrons and reduction as a gain of electrons. Understand that reduction and oxidation occur simultaneously. Assign oxidation numbers. Identify the oxidizing agent and the reducing agent. Write half-equations and balance the complete reaction using half-equations. Compare the reactivity of common metals (activity series) Predict the reaction products using the activity series.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 11. Elements of VII-A sub-group.	3/2/	Describe the halogens properties, chlorine, bromine and iodine in Group VII-A, as a collection of diatomic non-metals showing a trend in color and density and state their reaction with other halide ions. Identify trends in Groups, given information about the elements concerned.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as

				communication and chemical competence need open questions or other ways of assessing.
Theme 12. Elements of VI-A sub-group.	2/2/	Describe the chalcogens properties, oxigen, sulfur and selenium in Group VI-A. Predict the properties of the elements in Group VI-A, given data where appropriate. Identify trends in Groups, given information about the elements concerned.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 13. Elements of V-A sub-group.	2/3/	Describe the pnictogens properties, nitrogen, phosphorus, and arsenic in Group V-A. Predict the properties of the elements in Group V-A, given data where appropriate. Identify trends in Groups, given information about the elements concerned.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence

				need open questions or other ways of assessing.
Theme 14. General properties of metals.	2/2/	Describe the general chemical properties of metals. Write reactions with dilute and concentrate hydrochloric, sulfuric and nitric acids.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 15. Analytical chemistry as a science	2/2/	To know and use safety rules in executing chemical experiments. Understand what glassware, apparatus and reagents use for each analytical experiment.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of

				assessing.
Theme 16. Qualitative analysis	3/6/	Predict why cations of the Ist and anions of the 3^{d} analytical groups have no group reagent. Perform characteristic reactions of cations and anions. Determin of elements or ions, which are part of investigated substance.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Theme 17. Quantitative analysis	3/10/	Determine of the amount or percentage of one or more compounds of a sample. Know and use variety methods for quantitative analyses.	Perform in-class labs and provide data to complete lab reports. Tests of practical and theoretical skills. Complete learning through the independent study and wider reading for developing knowledge (including elearn). Solving exercises.	Assessing content knowledge can be done by written questions where the student has to respond on. Partly that can be done by multiple choice but competencies as constructing explanations and engaging in argument as well as key competencies as communication and chemical competence need open questions or other ways of assessing.
Total for 1 semester				**70**
Exam				**30**

Total for course	**100**

ASSESSMENT POLICY

Policy regarding deadlines and resits:	Assignments submitted after the deadline without valid reasons will be graded lower. Resitting of modules will be allowed with the permission from the lecturer and in the presence of valid reasons (e.g. medical reasons).
Academic honesty policy:	Cheating during tests and exams is strictly prohibited (including the use of mobile devices). Coursework and research papers must contain correct citations for all sources used.
Attendance policy:	Class attendance is mandatory. In case of objective reasons (such as illness or international internships), individual learning may be allowed (in online format by the approval of the dean of the faculty).

SCALE OF ASSESSMENT OF STUDENT KNOWLEDGE

Student rating, points	**National grade based on exam results**	
	exams	**credits**
90-100	excellent	passed
74-89	good	
60-73	satisfactory	
0-59	unsatisfactory	not passed

9. Technology and methodological requirements

1. Inorganic Chemistry. Manual. Voytenko L., Kopilevich V., Prokopchuk N. - Kyiv: NAU Publish., 2019. - 148 p.
2. Workbook on Inorganic Chemistry. Voytenko L., Prokopchuk N. - Kyiv: NAU Publish., 2019. - 85 p.

10. Required and recommended literature

Basic

1. Introduction in General, Organic and Biochemistry, 7th Edition, by Morris Hein, Leo R. Best, Scott Pattison and Susan Arena, Brooks/Cole Publishing Co., 2010, 872 pp.
2. Inorganic Chemistry, second edition, D. F. Shriver, P. W. Atkins, and C.H. Langford; W. H. Freeman and Co., New York, 2013, 913 pp.

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Supplemental

1. Concepts and Models of Inorganic Chemistry, third edition, B. E. Douglas, D. H. McDaniel and J. J. Alexander; John Wiley & Sons, Inc., New York, 1994. 993 p.
2. Inorganic Chemistry, A Modern Introduction, T. Moeller; John Wiley & Sons, New York, 1982. 846 p.
3. Chemistry of the Elements, N. N. Greenwoo and A. Earnshaw; Pergamon Press, New York, 1984. 1542 pp.

11. Normative literature

1. ISO 6353-2:1983 Reagents for chemical analysis -- Part 2: Specifications -- First series.
2. ISO 6058:1984, Water quality - Determination of calcium content - EDTA titrimetric method ISO 6058:1984, Water quality - Determination of calcium content - EDTA titrimetric method.

3. ISO 6059 – 1984 Water quality – Determination of the sum of calcium and magnesium – EDTA titrimetric method.

13. IT resources

1. https://elearn.nubip.edu.ua/course/view.php?id=1185
2. http://www.informika.ru/text/database/chemy/Enu/Data/Ch1-7.html
3. http://dbhs.wvusd.k12.ca.us/AcidBase/Kw.html
4. http://dbhs.wvusd.k12.ca.us/AcidBase/Hydrolysis.html
5. http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/bond.html
6. http://chemlab.pc.maricopa.edu periodic/triangletable.html
7. http://www.pc.chemie.uni-siegen.de/pci/versuche/english/kapite14. html