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___,semester1_
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. LavrikRuslan**
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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 AnalyticalChemistry 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
Module1. Theoretical Foundations of Inorganic Chemistry.				
Topic #1. Introduction. General Notions, Stoichiometrical Laws and Types of Chemical Reactions.	1/8/0	*Understand* general notions of chemistry and laws of Stoicheometry. *Analise and differentiate* various types of chemical reactions. *Express* chemical reaction through a chemical equation. *Provide* examples for different types of chemical reactions. *Predict* products of chemical reactions.	Laboratory training CLASSIFICATION OF INORGANIC SUBSTANCES. Control test "CLASSIFICATION OF INORGANIC SUBSTANCES".	5 30
Topic # 2. Atomic structure of chemical elements.	3/6/0	*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. *Explain* atomic properties using models of atomic structure that show locations and/or energies of sub-atomic particles.	Laboratory training ATOMIC STRUCTURE. CHEMICAL BONDING Control test "ATOMIC STRUCTURE. ELECTRON CONFIGURATIONS OF ATOMS. CHEMICAL BONDING"	5 10
Topic # 3. The Periodic Law and Periodic Table of chemical elements.	2/-/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… *Explain* reactivity of elements as a consequence of the electron arrangement in the outer shell;	Independent Study for Module#1	13

		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.		
Topic # 4. Chemical bonding and structure of molecules. Chemical kinetics and equilibrium.	4/4/0	*Use* the octet rule to explain the formation of ions and covalent bond formation. *Understand* that ionic bond is the electrostatic attraction between ions of opposite charge; *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, ionic, metallic bond(s); *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 the factors (concentration, temperature and active surface) affect the rate of reaction.	Laboratory training. THEORY OF ELECTROLYTIC DISSOCIATION Control test "THEORY OF ELECTROLYTIC DISSOCIATION"	5 12
Total hours (module 1)	10/18/5			
Total points of lab work for the first module				80
Control test for Module #1				20
Total points for module # 1				100
Module 2. Theoretical Foundations of Inorganic Chemistry.				
Theme 5. Solutions, their nature and properties.	2/0/5	*Define* what a solution is. *Illustrate* the different properties (conductivity) between molecular and	Independent Study for Module # 2	13

		ionic solutions. *Define* concentration (mass/volume).		
Theme 6. Electrolytes and reactions in their solutions.	2/6/0	*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.	Laboratory training OXIDATION-REDUCTION REACTIONS Control Test #1 "OXIDATION-REDUCTION REACTIONS" Control Test #2 "OXIDATION-REDUCTION REACTIONS"	5 10 12
Theme 7. Hydrolysis of salts. Ionic product of water. pH concept.	2/6/0	*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.	Laboratory training. HYDROLYSIS OF SALTS Control test "HYDROLYSIS OF SALTS"	5 20
Theme 8. Coordination compounds.	2/5/0	*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 coordination compounds.	Laboratory training #5. COMPLEX (COORDINATION) COMPOUNDS. Control Test "COMPLEX (COORDINATION) COMPOUNDS"	5 10
Total hours (module 2)	8/17/5			
Total points of lab work for the module №2				80
Control test for Module #2				20
Total points for module # 2				100

Module 3. Redox reactions. Chemistry of the elements.				
Theme 9. Redox reactions.	2/0/5	*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.	Independent Study for Module # 3	10
Theme 10. Elements of VII-A sub-group.	2/4/0	*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.	Laboratory training. THE FIRST GROUP OF CATIONS Laboratory training. THE SECOND GROUP OF CATIONS	10 10
Theme 11. Elements of VI-A sub-group.	2/6/0	*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.	Laboratory training. THE THIRD GROUP OF CATIONS	10
Theme 12. Elements of V-A sub-group.	2/6/0	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.	Laboratory training. THE FOURTH GROUP OF CATIONS Control Test "Analysis of Cations"	10 30
Total hours (module 3)	8/16/5			

Total points of lab work for the module №3				80
Control test for Module #3				20
Total points for module # 3				100
Module 4. Analytical Chemistry				
Theme 13. Qualitative analysis	2/12/0	*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. *Determine* of elements or ions, which are part of investigated substance.	Laboratory training. THE FIRST GROUP OF ANIONS Laboratory training. THE SECOND GROUP OF ANIONS Laboratory training. THE THIRD GROUP OF ANIONS Control Test "Anions. ANALYSIS OF UNKNOWN SUBSTANCE"	5 5 5 15
Theme 14. Quantitative analysis	2/12/5	*Determine* of the amount or percentage of one or more compounds of a sample. *Know* and use variety methods for quantitative analyses.	Laboratory training #15. Determination of alkali solution normality Control Test "Units of Concentration" Independent Study # 2 for Module 4	10 20 20
Total hours (module 4)	4/24/5			
Total course hours	**30/75/15**			
Total points of lab work for the module №4				80
Control test for Module #4				20
Total points for module # 4				100
Educatiolnal work				**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

Technology and methodological requirements

1. Methodological guidelines “Inorganic and analytical chemistry for bachelor students’ specialty 202 – “Plant Protection”. Voitenko L.V., Kopilevich V.A., Prokopchuk N.M. Lavryk R.V. – Kyiv: Експо-Друк., 2023. - 213 p.
2. Laboratory manual on Inorganic and Analytical Chemistry. Savchenko D.A., Voytenko L.V., Prokopchuk N.M.- Kyiv: Експо-Друк., 2020. - 217 p.

Required and recommended literature

1. General and Inorganic Chemistry: textbook / V.O. Kalibabchuk, V.V. Ohurtsov, V.I. Halynska et al.; edited by V.O. Kalibabchuk. — Kyiv: AUS Medicine Publishing, 2019. — 456 p.
2. Introduction in General, Organic and Biochemistry, 7th Edition, by Morris Hein, Leo R. Best, Scott Pattison and Susan Arena, Brooks/Cole Publishing Co., 2021, 872 pp.
3. Inorganic Chemistry, second edition, D. F. Shriver, P. W. Atkins, and C.H. Langford; W. H. Freeman and Co., New York, 2004, 913 pp.

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, 2014. 993 p.
2. Inorganic Chemistry, A Modern Introduction, T. Moeller; John Wiley & Sons, New York, 2008. 846 p.

3. Chemistry of the Elements, N. N. Greenwoo and A. Earnshaw; Pergamon Press, New York, 2004. 1542 pp.

IT resources

1. Introduction to inorganic chemistry: https://bit.ly/3IAEddt ;
2. Khan Academy about Chemical Reactions: https://bit.ly/3IDtn6u
3. Analytical chemistry. Laboratory Manual: https://bit.ly/3KHh63A
4. Virtual lab for Chemistry https://chemcollective.org/vlabs
5. Periodic Videos by Tedex platform https://ed.ted.com/periodic-videos
6. Modern dynamic Periodic Table of Elements http://bit.ly/3Z56Bf5