



COURSE SYLLABUS

"GENERAL AND INORGANIC CHEMISTRY"

Degree of higher education - Bachelor

Specialization 162 - „Biotechnology and bioengineering,,

Educational programme „Biotechnology and bioengineering,,

Academic year 1, semester 1

Form of study _____ full-time (full-time)

Number of ECTS credits 6

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=1201>

COURSE DESCRIPTION

(up to 1000 printed characters)

The natural sciences fall into two general categories – the biological sciences and the physical ones. The biological sciences are concerned primarily with the living things, and the physical sciences are concerned primarily with nonliving things, including rocks, the stars, electricity, the weather, energy from the sun, and the composition of all materials. Chemistry is a physical science.

In general, **Chemistry** is the study of the composition, structure, and the properties of substances and the changes they undergo. This definition may suggest to you that chemistry has little to do with everyday life. This is not true. Your way of life would be radically different without the practical applications of chemistry. Imagine a supermarket offering only fruits and vegetables grown without manufactured fertilizers and pesticides. The quantities and varieties offered would be far fewer. Imagine drinking water from your tap that had not been purified. The unpurified water would probably make you sick. Try to imagine a world without gasoline or heating oil. It would be very different from the world we live in.

Chemistry is a very broad subject. Most chemists would describe themselves as working in one of the following major areas of the science:

Organic chemistry - the study of substances containing carbon and hydrogen, and their derivatives;

Inorganic chemistry – the study of all substances not classified as organic chemicals, which includes the chemistry of all substances containing elements other than organic carbon;

Physical chemistry – the study of the properties, transformations, and interrelationships of energy and matter;

Biochemistry – the study of all substances and processes that occur in living things;

Analytical chemistry – the identification of substances and the qualitative and quantitative determination of the composition of materials.

A relative new direction of inorganic chemistry is *Bioinorganic chemistry*. Advances in bioinorganic chemistry since the 1970s have been driven by three factors: rapid determination of high-resolution structures of proteins and other bio-molecules, utilization of powerful spectroscopic tools for studies of both structures and dynamics, and the widespread use of macromolecular engineering to create new biologically relevant structures. Today, very large

molecules can be manipulated at will, with the result that certain proteins and nucleic acids themselves have become versatile model systems for elucidating biological function.

Oxidation-reduction processes continue to be a central theme of biological inorganic chemistry. Well over half of the papers in this special feature deal with biological red-ox reactions in one way or another.

So, to study a course of bioinorganic chemistry is to understand the basic principles of acid-base processes, reactions in the water medium (dissociation, hydrolysis), red-ox reactions, complexing reactions and so on.

Competencies of the educational programme:

*Integrative competency (IC):*The ability to solve complex specialized problems and practical problems characterized by complexity and uncertainty in biotechnology and bioengineering, or in the learning process, which involves the application of theories and methods of biotechnology and bioengineering. ___

General competencies (GC):

5. Ability to learn and master modern knowledge

9. The ability to preserve and multiply moral, cultural, scientific values and achievements of society on based on the understanding of history and patterns of development subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, use different types and forms of motor activities for active recreation and healthy living way of life.

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

2. Ability to use thorough knowledge of chemistry and biology to the extent necessary to achieve others results of the educational program

5. The ability to conduct experimental research with improvement of biological agents, including to cause changes in the structure of the hereditary apparatus and functional activity of biological agents_

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

_ 1. To be able to apply modern mathematical methods for solving practical problems related to research and design of biotechnological processes. Use knowledge of physics for analysis biotechnological processes

22. Be able to take into account social, ecological, ethical, economic aspects, labor and industrial safety requirements sanitation and fire safety during the formation of technical solutions. Be able to use different types and forms of motor activities for active recreation and healthy living way of life.

COURSE STRUCTURE

Topic	Hours (lecture/laboratory, practical/ self)	Learning outcomes	Tasks	Assessment
1 semestr				
Module1				
Lecture # 1. Introduction to Chemistry & the Nature of Science	2/4/5	What is necessary to know , What one should be able to do, What one should be concerned in: The natural sciences fall into two general	LABORATORY TRAINING Nº 1. CHEMICAL NAMES AND FORMULAS. OXIDATION NUMBERS. GENERAL NOTIONS OF ATOMIC-MOLECULAR STUDY	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;

		<p>categories – the biological sciences and the physical ones. The biological sciences are concerned primarily with the living things, and the physical sciences are concerned primarily with nonliving things, including rocks, the stars, electricity, the weather, energy from the sun, and the composition of all materials. Chemistry is a physical science.</p>		
<p>Lecture # 2. The Structure of the Atom</p>	2/4/5	<p>What is necessary to know, What one should be able to do, What one should be concerned in: The Structure of the Atom</p>	<p>Laboratory Training #2 CLASSIFICATION OF INORGANIC SUBSTANCES. TYPES OF THE CHEMICAL REACTIONS</p>	<p>-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;</p>
<p>Lecture # 3. The Organization of the Elements</p>	2/4/5	<p>What is necessary to know, What one should be able to do, What one should be concerned</p>	<p>LABORATORY TRAINING № 3. ATOMIC STRUCTURE. CHEMICAL BONDING -Theoretical control tests</p>	<p>-Control of lab works preparation; - Theoretical control</p>

		in: With all of the compounds of all of the elements to be identified, systematic methods for writing formulas and naming compounds are necessary. In this section you will be introduced to the rules that apply to simple chemical compounds.		tests; -Control experimental problems;
Module 2				
Lecture # 4. The main classes of inorganic compounds	2/4/5	What is necessary to know, What one should be able to do, What one should be concerned in:	LABORATORY TRAINING Nº 4. REACTIONS IN AQUEOUS SOLUTIONS - control tests	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 5. Types of Chemical Bonds	2/4/3	What is necessary to know, What one should be able to do, What one should be concerned in: Types of Chemical Bonds	LABORATORY TRAINING Nº 5. Hydrolysis of salts	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 6. General Properties of Aqueous	2/4/5	What is necessary to know, What one should	LABORATORY TRAINING Nº 6. Complex compounds - control tests	-Control of lab works preparation

Solutions		be able to do, What one should be concerned in: General Properties of Aqueous Solutions		n; - Theoretical control tests; -Control experimental problems;
Lecture # 7. Chemical equilibrium	2/4/2	What is necessary to know , What one should be able to do, What one should be concerned in: Chemical equilibrium	LABORATORY TRAINING Nº 7. Chemical equilibrium-control tests	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
• Module 3				
Lecture # 8. Arrhenius's classification of compounds. Features of reactions in aqueous solutions	2/4/5	What is necessary to know , What one should be able to do, What one should be concerned in: Arrhenius's classification of compounds. Features of reactions in aqueous solutions	LABORATORY TRAINING Nº 8. OXIDATION-REDUCTION REACTIONS SKILL-DEVELOPING EXERCISES	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 9. Hydrolysis of salts	2/4/2	What is necessary to know , What one should be able to do, What one should be concerned in: Hydrolysis	LABORATORY TRAINING Nº 9. VII-A group of chemical elements The Halogens- control tests	-Control of lab works preparation; - Theoretical control tests; -Control experimental

				ntal problems;
Lecture # 10. Oxidation-reduction reactions	2/4/5	What is necessary to know , What one should be able to do, What one should be concerned in: Oxidation-reduction reactions	- control tests LABORATORY TRAINING. RED -OX Reactions.	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 11. Coordination compound	2/4/3	What is necessary to know , What one should be able to do, What one should be concerned in: Coordination CHEMISTRY	- control tests LABORATORY TRAINING. Coordination CHEMISTRY	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
• Module 4				
Lecture # 12. Halogens	4/4/2	What is necessary to know , What one should be able to do, What one should be concerned in: Halogens	- control tests LABORATORY TRAINING. Property of Halogens	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 13. Chalcogens	4/4/2	What is necessary to know , What one should be able to do, What one should be concerned	LABORATORY TRAINING. Chalcogens	-Control of lab works preparation; - Theoretical control

		in: Chalcogens		tests; -Control experimental problems;
Lecture # 14. VA group of elements	4/6/2	What is necessary to know , What one should be able to do, What one should be concerned in:	- control tests LABORATORY TRAINING. VA group of elements	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 15. IVA group of elements	3/6/2	What is necessary to know , What one should be able to do, What one should be concerned in:	LABORATORY TRAINING. IVA group of elements	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 16. Chemistry of iron	4/6/2	What is necessary to know , What one should be able to do, What one should be concerned in: Chemistry of iron	- control tests LABORATORY TRAINING. Chemistry of iron	-Control of lab works preparation; - Theoretical control tests; -Control experimental problems;
Lecture # 17. Alkali and Alkaline Earths Metals	4/5/5	What is necessary to know , What one should be able to do, What	- control tests LABORATORY TRAINING. Chemistry of iron and Alkaline Earths Metals	-Control of lab works preparation; -

		one should be concerned in: Alkali and Alkaline Earths Metals		Theoretical control tests; -Control experimental problems;
Total	45/75			
Self Tr. Work	60			
Total				70
Exam				30
Total for course				100

ASSESSMENT POLICY

<i>Policy regarding deadlines and resits:</i>	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).
<i>Academic honesty policy:</i>	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.
<i>Attendance policy:</i>	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. Analytical Chemistry: Tutorial : [for students of higher educational institutions III-IV accreditation level, speciality 162 Biotechnologies and Bio-engineering»] / Voitenko L.V., Prokopchuk N.M., Lavrik R.V.,– Kyiv: NULES Publ., 2018. – 402 p.
2. Introduction in General, Organic and Analytical Chemistry, 7th Edition, by Morris Hein, Leo R. Best, Scott Pattison and Susan Arena, Brooks/Cole Publishing Co., 2010, 872 pp.
3. Chemistry: the Molecular Nature of Matter and Change, 2nd ed. Martin S. Silberberg, McGraw-Hill Companies, 2000, 1086 pp.
4. Chemistry. Raymond Chang, 6th ed., McGraw-Hill Companies, 2008, 993 pp.

5. Analytical Chemistry, second edition, D. F. Shriver, P. W. Atkins, and C.H. Langford; W. H. Freeman and Co., New York, 1994, 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, 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. Greenwood 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>