BIOCHEMISTRY

Department of Physiology, Biochemistry plants and Bioenergetic

Faculty of Plant protection, Biotechnology and Ecology

Lecturer	**Prof. Svitlana Prylutska**
Term	**3rd semester, 2nd year**
Major	**Bachelor or Master degree**
ECTS credits	**4**
Control	**Exam**
Class-room hours	**30 hours (of them: lectures – 14 hours, laboratory classes – 16 hours)**

Subject overview

Discipline is studying the structure, chemical composition of living organisms, including plants, determining the general regularities of different metabolic pathways and the interconnections between them, both in cells and in the organism as a whole. Students is learning the basic classes of bioorganic molecules, their functions, properties and pathways; the metabolic pathways convert organic compounds, the relationship between them and the possibility of regulation of metabolic processes topography.

The theoretical aspects of the discipline are fixed on laboratory studies, so students need to obtain and consolidate skills at work in biochemical laboratories that allow in the further will plan the research and analyze experimental data.

The student should know:

- the structure, the function of bioorganic molecules,
- paths of synthesis and decay of biological compounds,
- paths of metabolic regulation,
- general patterns of energy metabolism *in vivo*.

The student should be able to:

- use new knowledge during working with biological objects,
- do qualitative and quantitative analysis of major classes of bioorganic compounds,
- learn and master modern biochemical methods for their identification.

Lectures:

1. Introduction to the Biochemistry. Modern biochemical methods.
2. The molecular and chemical composition of living organisms. The molecular and supramolecular organization of cells.
3. Protein – structure, functions, classification and properties. Amino acids. The levels of structural organization of protein.
4. Structure, properties and functions of carbohydrates.
5. Nucleic acids. Structure and properties of DNA and RNA.
6. Structure, properties and functions of lipids.
7. Metabolism of substances and energy. Enzymes.

Laboratory classes:

1. Qualitative determination of minerals.
2. Color (qualitative) reactions on proteins and amino acids.
3. Physical and chemical properties of proteins. Reactions precipitation of proteins.
4. Qualitative reactions to monosaccharides and polysaccharides. Hydrolysis of starch and cellulose.
5. Solubility of lipids. Emulsion formation.
6. Quantitative determination of protein using Biuret reagent. The construction of the calibration curve to determine the protein concentration by kit assay using albumin calf serum.
7. Selecting of nucleoproteides from yeast. Qualitative reactions on components of nucleproteides (proteins, monosaccharides (ribose and deoxyribose), purine bases, phosphoric acid).
8. Properties of enzymes (termolability, pH). Activity of enzymes (amylase and catalase).

CHEMISTRY (INORGANIC AND ANALYTICAL)

Department of Analytical and Bioinorganic Chemistry & Water Quality

Agrobiological faculty

Specialty 162 Biotechnologies and bioengineering

Lecturer	**Larysa Voitenko**
Term	**The 1st**
Major	**Bachelor degree**
ECTS credits	**5**
Control	**Exam**
Class-room hours	**120 hours (of them: lectures – 60 hours, laboratory classes – 60 hours)**

Subject overview

Inorganic chemistry studies the theoretical foundations of the modern inorganic chemistry, including the chemical properties and transformations of macronutrients, micronutrients, toxic elements and their compounds. Chemical properties are described in terms of atomic-molecular studies, acid-base chemistry, redox processes and complexation. The laboratory course involves the preparation and study of a number of types of inorganic and complex compounds.

Analytical chemistry (chemical analysis) is the area of chemistry responsible for characterizing the composition of matter, both qualitatively (what is present) and quantitatively (how much is present). Course includes: (1) the qualitative tests of cations and anions; (2) methods of identification of soluble and insoluble substances; (3) gravimetric analysis; (4) volumetry (neutralization, RedOx methods, precipitation titrimetry; complexonometry).

Lectures:

1. Chemistry as the science that deals with the properties, composition, and structure of substances.
2. Atomic structure of chemical elements.
3. Periodicity of changes in structure and properties of elements and their compounds.
4. Chemical bonding and molecular structure.
5. Chemical kinetics and equilibrium
6. Solutions and their properties. Electrolytes and electrolytic dissociation. Ionic equations.
7. Hydrolysis of salts. Notion of a pH.
8. RedOx processes.
9. Complex (coordination) compounds.

10. Subjects and objects of the chemical analysis (analytical chemistry). Methods of quantitative analysis. Subjects of qualitative and quantitative analyses. Methods of qualitative analysis. Analytical reactions and requirements to analytical reactions.
11. Chemical-analytical properties of the cations on the examples of s-elements belongs to IA and IIA groups, p- elements belongs to IIIA and IVA groups, and d-elements of the IIIB and VB groups.
12. Chemical-analytical properties of the cations on the examples of p-elements belong to VIIA, VIA, VA, and IVA groups. Qualitative analysis of inorganic substances (salts, acids, bases, oxides).
13. Equilibrium in heterogeneous and homogeneous systems. Precipitation and sediment dissolving reactions; their application for qualitative and quantitative analysis
14. Theoretical foundations of measurement and processing of results in chemical analysis. The essence and task of quantitative measurements and calculations.
15. Titrimetric methods of quantitative analysis (volumetry). The application of volumetric methods in environmental analysis. Neutralization method.
16. RedOxmetry in quantitative analysis.
17. Complexonometry in quantitative analysis.

Laboratory classes:

1. Introduction. Lab Safety rules. Semimicro qualitative lab techniques. The introduction testing.
2. General chemical properties of main classes of inorganic substances. Chemical naming.
3. Electron formulas compiling. Determination of valence and oxidation number of the chemical elements as a function of their electron configuration. Electron configuration simulation.
4. Periodicity as an expression of electron shell structures. Visualisation of the periodicity.
5. Qualitative assessment of chemical bonding types and molecular structure of acids, bases, salts, oxides. Virtual simulation of chemical bonds and visualization of molecules.
6. Experimental studding of strong and weak electrolytes from viewpoint of Avogadro's electrolytic dissociation theory. How to compile the ionic equations. How to use the net ionic calculator.
7. Experimental studding of hydrolysis of salts in water medium. How to predict and to measure of a pH. How to use a Hydrolysis calculator.
8. Experimental studding of RedOx processes; chemical nature of Reducing and oxiding agents. RedOx potential and its measuring in water medium. Electron balance and half-reaction methods. How to use a RedOx calculator.

9. Experimental studding of complexing processes. How to isolate and decompose the coordinative compounds. IUPAC nomenclature of coordinate compounds.

10. Introduction to qualitative analysis. Classification of cations, qualitative tests of cations.

11. Studding of chemical-analytical properties and qualitative tests of anions belongs to p-elements of VIIA, VIA, VA, IVA and IIIA groups.

12. Analytical classification of the main bioactive cations. Separation and identification of I-IV cation groups according to the ammine-phosphate classification.

13. Analytical classification of the main bioactive anions. Separation and identification of anions.

14. The identification methods of the inorganic substances qualitative analysis. Two experimental control tasks for the analysis of chemical composition.

15. Experimental strategies of quantitative analysis: weighing, measuring vessels, filtering. Volumetric analysis. Calculations in volumetric analysis. Neutralization method. Preparation of primary and secondary standard solutions.

16. Experimental control tasks: Concentration of alkali in water solution; Determination of temporary water hardness of water sample.

17. RedOx volumetric methods of quantitative analysis. Preparation of primary and secondary standard solutions of Permanganatometry and Iodometry. Experimental control tasks: The permanganatometric determination of Fe(II) concentration in water solution of Mohr's salt; The iodometric determination of Cu(II) content in solid copper vitriol.

18. Complexonometric volumetric method of quantitative analysis. Preparation of primary and secondary standard solutions of Trilonometry method. Experimental control tasks: Determination of total water hardness of water sample; Determination of Calcium content in water solution.

INDUSTRIAL BIOTECHNOLOGY

Department of Ecobiotechnology and biodiversity

Faculty of Plant Protection, Biotechnologies and Ecology

Lecturer	**Boroday Vira**
Term	**6 semester**
Major	**Bachelor degree**
ECTS credits	**4,0**
Control	**Exam**
Class-room hours	**120 hours (of them: lectures – 45 hours, laboratory classes – 30 hours)**

Subject overview

The purpose of study of discipline is a capture to knowledge and abilities of using basic biotechnological processes to obtain biologically active compounds, principles and methods of designing biotechnology facilities, cultivation of individual strains of industrial microorganisms, methods of selection of biological agents to obtain individual products, basics of microorganism cultivation management and quality control of the obtained product, determination of ecological safety of biotechnology products created on the basis of genetically modified microorganisms.

As a result of studying the discipline the student must be able to manage the processes of cultivation of microorganisms in industrial conditions by collecting, processing and analyzing information, experimental development of methods of working with various industrial microorganisms in the laboratory and during training practices in research institutions and biochemical enterprises.

Lectures:

1. History and achievements of industrial biotechnology.
2. Methods of Industrial Biotechnology.
3. Upstream Processing. Raw materials for fermentation media.
4. Upstream Processing. Large scale sterilization. Sterilization in fermentation processes.
5. Upstream Processing. Microorganisms - producers. Methods of isolation.
6. The methods of improvement of strain producers.
7. Metabolic pathways for the biosynthesis of industrial biotechnology products.
8. The types of metabolism of microorganisms. Production of Primary and Secondary Metabolism.

9. The main ways of producer microorganisms overproduction, characteristics of growth curve.
10. Maintenance of producers strains
11. Fermentation Process. Structure and types of fermentors.
12. Classification of fermentation processes.
13. Fermentation design and operation. Scale up process of the fermentation process.
14. Microbial growth kinetics. The Population growth curve. ‘
15. Monitoring of microbial growth in culture.
16. Stages of Downstream Processing.
17. Quality control of microbial products.
18. Alcoholic beverage industry.
19. Amino acids and organic acid production.
20. Antibiotic production.

Laboratory classes:

1. Equipment and Materials of Laboratory of Industrial Biotechnology. Methods of sterilization equipment and culture media.
2. Principles and methods for culturing microorganisms-producers and in biotech manufacturing.
3. Initial screening of microorganisms - antagonists in rhizosphere of plants.
4. Isolation of pure cultures of microorganisms – antagonists. Cultivation of microorganisms - antagonists on selective nutrient media.
5. The investigation of microbial antagonism.
6. Determination of the sensitivity of microorganisms to antibiotics.
7. Determination of enzymatic activity of oxidase and catalase microorganisms.
8. Cultivation of *Aspergillus niger* on media of different composition of macro-and micronutrients
9. The citric acid production by the fungus *Aspergillus niger*
10. The efficacy of biological products against bacterial blight pathogen of plants *Pectobacterium* spp.
11. Standardization and quality assessment determination of biological titer biopreparations.
12. Standardization and quality assessment of biopharmaceuticals by determining the biological activity of microorganisms – producers.

INTRODUCTION TO THE PROFESSION

Department of Physiology, Biochemistry plants and Bioenergetic

Faculty of Plant protection, Biotechnology and Ecology

Lecturer	**Prof. Svitlana Prylutska**
Term	**3rd semester, 2nd year**
Major	**Bachelor or Master degree**
ECTS credits	**4**
Control	**Exam**
Class-room hours	**30 hours (of them: lectures – 18 hours, practical or laboratory classes – 12 hours)**

Subject overview

Biotechnology is an interdisciplinary field that arose at the intersection of biological, chemical and technical sciences. The development of biotechnology is associated with the solution of global problems of humanity - elimination of shortages of food, energy, mineral resources, improvement of the quality of health care and the state of the environment. The contribution of biotechnology to agricultural production consists in facilitating the traditional methods of plant and animal selection and the development of new technologies that allow increasing the efficiency of agriculture. The discipline "Introduction to the profession" is one of the important sections of biotechnology related to the practical implementation of acquired knowledge in biotechnological industries, which uses theoretical and methodological provisions of molecular biology and genetics, microbiology, biochemistry, physiology and cytology, as well as the latest chemical technologies.

Lectures:

1. Biotechnology as a branch of science.
2. Prospects of industrial biotechnology.
3. Current state of environmental biotechnology. Ecobiotechnological approaches to environmental protection.
4. Development of alternative bioenergy.
5. Prospects of agricultural biotechnology.
6. Basic principles of biosafety and bioethics in biotechnology.
7. Current state of biomedical technologies.
8. Perspectives of food biotechnology. Food and biological supplements.
9. Basic principles of nanobiotechnologies in agriculture.

Practical classes:

1. Modern biotechnological methods.
2. Biotechnology of cultivation of isolated cells and tissues.
3. Culture of isolated protoplasts as a basis of cell engineering.
4. Microorganisms as classic objects of cell biotechnology.
5. Animal cells as producers of biologically active substances.
6. Plant cells and Mushrooms as objects of biotechnology.

MICROBIOLOGY AND VIROLOGY (VIROLOGY)

Department of Ecobiotechnology and biodiversity

Faculty of Plant Protection, Biotechnologies and Ecology

Lecturer	**Antipov Igor**
Term	**Semester 2**
Major	**Bachelor or Master degree**
ECTS credits	**2**
Control	**Exam**
Class-room hours	**45 hours (of them: lectures – 15 hours, practical or laboratory classes – 30 hours)**

Subject overview

Microbiology and virology (virology) is a mandatory component of training in the specialty Biotechnology and Bioengineering, which provides basic concepts regarding the concept of viruses, their chemical composition and morphological structure. The features of viral nucleic acids and proteins, ways of spreading and spreading viral infections, pathogenic processes of viral damage, methods and methods of diagnosis and identification of viruses are subject to study. The study of the discipline "Microbiology and Virology (Virology)" provides the mastery of such general competencies as knowledge and understanding of the subject area, the ability to search, process and analyze information from various sources, the ability to apply knowledge in practical situations. The study of the discipline "Microbiology and Virology (Virology)" provides the mastery of such professional competencies as the ability to use modern knowledge of viruses for effective use in biotechnology

Lectures:

1. Phytovirology is the science of studying plant viruses in biogeocenosis. History and Modern Principles of Nomenclature and Classification of Plant Viruses.
2. General characteristics of plant viruses.
3. Diagnostics and identification of viruses.
4. Features of virus reproduction.
5. Measures to prevent viral infections.

Classes:
(practical, laboratory classes)

1. Biotest.
2. Polymerase chain reaction.
3. Primers design.
4. Microscopy.
5. Enzyme-linked immuno sorbent assay, ELISA.

OBJECTS OF BIOTECHNOLOGICAL PRODUCTION

Department of Physiology, Biochemistry plants and Bioenergetic

Faculty of Plant protection, Biotechnology and Ecology

Lecturer	**Andriy Babytskiy**
Term	**3 semester**
Major	**Bachelor degree**
ECTS credits	**5**
Control	**Exam**
Class-room hours	**45 hours (of them: lectures – 30 hours, practical or laboratory classes – 15 hours)**

Subject overview

The course introduces various groups of organisms used in biotechnological production, as well as the biological processes that occur during the biotechnological production of target substances. During the teaching of the course, special attention is paid to the biochemical transformation of substrates into products, the production of which is the goal of the biotechnologist. Purpose of studying the principles of biotechnological processes technologies, technical tools that provide them, and how to determine the main parameters of the raw materials and products of biotechnological processes.

Objectives to give deep knowledge of the principles and processes of the theory of business processes and technological adjustment of basic parameters for controlling bioprocesses that are necessary for their highly efficient use in agricultural production, research aimed at improving existing and developing new technical solutions.

Lectures:

1. Morphological structure of the shoot.
2. Morphological structure and variety of buds and stems.
3. Morphological structure of leaves. Metamorphosis of leaves.
4. Morphological structure and metamorphosis of the root.
5. Features of morphological organization of a flower.
6. Morphological diversity of inflorescences.
7. Morphological diversity of seeds and fruits.
8. Meristematic and integumentary tissues.
9. Basic, mechanical and conductive tissues.
10. Excretory structures.
11. Anatomical structure of the stem.
12. Anatomical structure of the leaf and root.
13. Anatomy of generative organs.

Classes:

(practical, laboratory classes)

1. Morphological features and diversity of shoots and their constituent organs.
2. Morphological features and diversity of roots, their metamorphoses and modified shoots.
3. Morphological features of generative organs of plants.
4. Meristematic and integumentary tissues.
5. Secretive structures.
6. Anatomical structure of generative organs of plants.
7. Variety of mosses.
8. Variety of gymnosperms.
9. Variety of angiosperms. Class Monocotyledons.

PHYSICS

Department of Physics

Education and research institute of Energetics, Automatics and Energy saving
Specialty 162 Biotechnologies and bioengineering

Lecturer	**candidate of physical and mathematical sciences, associate professor Oksana Godlevska**
Term	**1**
Major	**Bachelor**
ECTS credits	**4**
Control	**Exam**
Class-room hours	**60 hours (of them: lectures –30 hours, practical or laboratory classes – 30 hours)**

Subject overview

The discipline " Physics" is one of the main parts of the theoretical training of bachelors in the specialty162 "Biotechnologies and bioengineering", that is, the basis without which a full study of the disciplines of the cycle of professional and practical training of such specialists is impossible.

The Purpose of studying the discipline "Physics" is the consistent study by students of the basic laws and provisions of physics in order to understand the general regularities of natural phenomena; the use of these laws in the prompt resolution of problems; illumination of possible applications of physical methods and devices in practical activities.

The tasks of the academic discipline "Physics" are as follows:

Providing students with sufficiently broad training in the field of physics, mastery of fundamental concepts and theories of classical and modern physics, which provides them with effective mastery of special subjects and the further possibility of using physical principles. This also includes teaching students methods and skills for solving specific problems and familiarizing them with measuring equipment.

Formation of students' scientific outlook and modern physical thinking. This task should also be considered as an essential part of the humanitarian training of the future specialist, since most issues of the history of science and philosophy can be demonstrated during the teaching of a physics course. As a result of studying the academic discipline "Mathematics and Physics", the student should know:

-basic physical quantities, units of their measurements, basics of error theory and rules for processing measurement results, modern means of measuring physical quantities

- fundamental concepts and theories of classical and modern physics in order to effectively master special educational disciplines and use knowledge of physical laws in future work;

- methods of solving practical physical problems and problems;

- principles of operation of devices;

be able to:

- use measuring tools, perform mathematical and statistical processing of measurement results;

- using physical conditions, laws and theories, apply the acquired theoretical and practical knowledge after studying special disciplines in the future work in the specialty;

- explain physical processes and phenomena that occur in the natural environment, as well as during the operation of various types of equipment.

Final control is carried out in the form of tests for each of the modules and an exam.

Lectures:

1. Mathematical data processing.
2. Kinematics of a material point.
3. Dynamics of a material point.
4. Work and energy.
5. Dynamics of rotary motion.
6. Fundamentals of molecular kinetic theory.
7. . Basics of hydrodynamics and aerodynamics.
8. Basics of thermodynamics.
9. Electrostatics.
10. Direct current.
11. Magnetic field. The phenomenon of electromagnetic induction.
12. Harmonic oscillations.
13. Waves.
14. Geometric optics.
15. Physics of the atom and atomic nucleus.

Classes:

(practical, laboratory classes)

1. Statistical calculations (error, significant figure, rounding).
2. Determining the acceleration of free fall using a mathematical pendulum.
3. Determination of Young's modulus of elastic substances.
4. Determination of the moment of inertia of a torsional pendulum.
5. Determination of the rate of sedimentation of bodies and the coefficient of internal friction of a liquid by the Stokes method.

6. Determination of the ratio of specific heat capacities C_p/C_V of gas by the method of adiabatic expansion (Clément-Desormes method).
7. Determination of the surface tension of a liquid by the droplet separation method.
8. Determination of entropy change during melting of tin.
9. Study of the electrostatic field.
10. Determination of the electromotive force of the current source by the compensation method.
11. Determination of the specific charge of an electron using the magnetron method.
12. Determination of the horizontal induction component of the Earth's magnetic field.
13. Determination of refractive indices using a microscope.
14. Determination of the wavelength of light using a diffraction grating.
15. Determination of Planck's constant by the Lukyrskyi method.

PROTEOMICS AND GENOMICS OF VIRUSES

Department of Ecobiotechnology and biodiversity

Faculty of Plant Protection, Biotechnologies and Ecology

Lecturer	**Antipov Igor**
Term	**5**
Major	**Bachelor or Master degree**
ECTS credits	**2**
Control	**Exam**
Class-room hours	**45 hours (of them: lectures – 15 hours, practical or laboratory classes – 30 hours)**

Subject overview

Proteomics and genomics of viruses is a mandatory component of training in the specialty Biotechnology and Bioengineering, which provides basic concepts regarding the structure of plant viruses and the processes of replication and synthesis of viruses, genetic features. The main pathways of molecular biological processes that ensure the replication of viruses are subject to study. Considerable attention is paid to the study of the structure and composition of viral genomes. The study of the discipline "Proteomics and Genomics of Viruses" provides the acquisition of such professional competencies as the ability to use modern knowledge about the patterns of viral replication for the effective use of relevant processes in biotechnological practice.

Lectures:

1. Fundamentals of Genetic Databases. Their varieties and purposes of use.
2. Working with virus genomes.
3. The Use of Bioinformative Databases for Phylogenetic Studies Plant Virusesas the Basis of Genetic Engineering.

Classes:

(practical, laboratory classes)

1. Introduction to Nucleotide Sequence Analysis Software.
2. Registration of your own account on the platform National central of biotechnolocal information .
3. Research of functions and information.
4. Formation of a list of nucleotide sequences of isolates for phylogenetic analysis.
5. Construction of phylogenetic trees. Use of a number of models.
6. Construction of phylogenetic trees. Use of a number of methods.
7. The use of bioinformative methods to create a given consensus sequence.

RADIOBIOLOGY AND RADIOECOLOGY

Department of General Ecology, Radiobiology and Life Safety

Faculty of Plant Protection, Biotechnologies and Ecology

Lecturer	***Doctor in Biology Alla Klepko***
Term	**3rd course (6th semester)**
Major	**Bachelor degree**
ECTS credits	**4**
Control	**Exam**
Class-room hours	**30 hours (of them: lectures – 15 hours, practical classes – 15 hours)**

Subject overview

The course covers the principles of agricultural radiobiology and radioecology. It introduces the biological impacts of ionizing irradiation, radionuclide migration in the environment and agricultural objects, and the basic concepts of radioecological and dissymmetric monitoring. It presents the structure of the radiation control system, methods for assessing and normalizing doses, and permissible levels of radioactive contamination in accordance with Ukrainian radiation safety norms. It analyses countermeasures in detail for reducing the transfer of radionuclides into agricultural production and foodstuffs, as well as ways to apply ionizing irradiation in agricultural practice.

Lectures:

1. Introduction. Radiobiology and radioecology as a single science.
2. Radioactivity, types of ionizing radiation and their dosimetry.
3. Sources of ionizing radiation on Earth.
4. Physical basis of interaction of ionizing radiation with substances of cells of living organisms.
5. Biological effects of ionizing radiation in plants and animals and radiosensitivity of plants, animals and other organisms.
6. Anti-radiation biological protection and radiosensitisation and post-radiation recovery of plants and animals.
7. Atmosphere and soil as initial stages of radionuclide migration in the environment. Radionuclide intake from soil to plants and animals, biological effect of incorporated radionuclides.
8. Measures to reduce the intake of radionuclides in crop and livestock products and their purification from radionuclides through primary technological processing.

Practical classes:

1. Rules for working with radiation sources in radiological laboratories.
2. Determination of γ-radiation dose rate generated by a reference source of ^{137}Cs through protective materials.
3. Determination of the flux of β-particles from the reference source.
4. Measurement of γ-background in the premises and on the territory by radiometer SRP-68-01.
5. Measurement of specific and volumetric activity of β-emitting radionuclides on the Beta radiometer.
6. Determination of the half-attenuation layer of β-radiation.
7. Rapid determination of cesium radionuclides in water, soil, food and agricultural products by γ-radiation on the RUB-01-P6 radiometer.
8. Determination of ^{137}Cs content in the human body by RUB-01-P6 radiometer.