**UNSA\_PRIRODNO-MATEMATIČKI FAKULTET**

**HEMIJA/CHEMISTRY**

**Imunohemija /Immunochemistry**

**Doc. dr. Saida Ibragić**

The aim of the course is to introduce students to the chemistry of immune responses and reactions. The course gives basic theories within the area of cellular and molecular immunology enabling the students to understand the structure and roles of molecules that have key functions in the immune system. The focus is placed on modern immunochemical methods used in research and clinical practice such as serological methods, immunoelectrophoresis, nephelometry, ELISA assays, immunodiffusion methods etc. The value of diagnostic parameters obtained by immunochemical methods are elaborated using the example of paraproteins in multiple myeloma. Students are graded based on their interactive participation in classes and written exam results.

**Laboratorij II u funkciji analize artefakata /Laboratory II in Analysis of Artifacts**

**Doc. dr. Saida Ibragić**

In the preservation of cultural heritage the work of scientists is as indispensable as the work of art restorers. This course is designed to familiarize students with the main organic components

commonly found in artwork and to teach them principles of analytical methods that can be employed in order to characterize materials, determine their chemical composition and guide them in correct decision-making during the restoration or conservation process. The module includes lessons with many practical examples, targeted discussions and laboratory classes. Students are graded based on their interactive participation in classes and exam results.

**Analitičke metode u forenzičkoj hemiji /Analytical Methods in Forensic Chemistry**

**Prof. dr. Mustafa Memić / Doc. dr. Saida Ibragić**

This course approaches the challenges, methods and analyses of forensic science from a fundamental, chemical perspective. Lecture topics include drug analysis, analysis of paint, arson, explosives, fibers and polymer materials. On completion of the course the student shall be able to identify, outline and assess the value of different analytical techniques used for forensic applications. The course will also promote synthesis of knowledge gleaned from related learning units and current accredited forensic practices. Apart from formal lectures, targeted discussions and laboratory experiences are used, as well. Student assessment is based on written exams and passed laboratory course.

**BIOLOGY**

**Molekularna biologija / Molecular biology**

**Prof. dr. Lada Lukić Bilela**

Molecular Biology course gives in-depth knowledge of biological processes through the investigation of the underlying molecular mechanisms as well as understanding of biochemical and molecular processes that occur in and between cells. The module allows to expand the knowledge of many areas: the structure and functions of information macromolecules; regulation of gene expression; structure, function and genome evolution; subcellular structures; signal transduction and cell communication; molecular mechanisms of disease, and application of molecular methods in biotechnology, medicine, biomedical and related scientific disciplines. Students will be able to describe and explain molecular processes in the cell and understand the most significant molecular and cell-based methods used in modern life sciences.

**Etologija / Ethology**

**Prof. dr. Lada Lukić Bilela**

The module enables understanding of biology and behavioural psychology: causes, patterns and natural behaviours of different species; physiological/anatomical basis of behaviour; nervous-endocrine system - from the simplest to the most complex forms and considers individual and social behaviour with focus on societal development and interspecies association. Special assignments are focused on the understanding of nature and dependence of individual, group and social behaviour; the understanding of the animal and human behaviour in accordance with their genetic/physiological profile and related to their own integrity in different situations. Realization of the objectives and tasks of this module contributes to new knowledge of the complexity of interaction between genetic, physiological and ecological factors in different forms of behaviour of animals and humans.

**Regulatorni mehanizmi životinja / Regulatory mechanisms of animals**

**Prof. dr. Lada Lukić Bilela**

The module provides a comparative overview of numerous regulatory mechanisms in animals, regulatory mechanisms at the cellular and molecular levels during ontogenesis and phylogenesis. Particularly emphasized are the biochemical and physiological mechanisms of homeostasis, their molecular basis as well as the most important supervisory systems in organism and the mechanisms of pathogenesis. A comparison of regulatory mechanisms and their evolution, from the simplest to the most complex animals, is the basis of modern settings in pathophysiology, bioactive substances and a new drugs designing. By achieving the objectives of this module, it is possible to understand the complex regulatory mechanisms, the significance of biochemical and physiological processes taking place at the molecular and cellular level, contributes to the integration of the organism and strict control of the homeostasis regulation.

**Genomika / Genomics (Elective)**

**Prof. dr. Lada Lukić Bilela**

The module enables the acquisition of knowledge about the genome structure, organization, function and evolution, in order to apply molecular-genetic and biotechnological approaches in biological, biomedicine, agrobiotechnological and other related sciences. Understanding the genome function is essential in analysis of hereditary material evolution. The knowledge of basic mechanisms involved in genome structure, organization, function and evolution is essential in understanding of applied biological and biomedical and biotechnological scientific fields.

**Biologija kancera / Cancer biology**

**Prof. dr. Izet Eminović**

The course includes all biological aspects of tumours, such as biomedical, cellular, biochemical, molecular, genetic and immunological characteristics. Students will also learn about the techniques used in diagnostics and tumour research. In addition, student will develop a comprehensive understanding of the principles of core topics in current areas of cancer biology and their relationship to other medical disciplines. Students will also learn how to plan, carry out and report on scientific research and diagnostic results of cancers. On successfully completing the module students will be able to better understand the nature of cancer and processes that underlie cancer formation and progression; learn the basic principles of cancer formation, diagnostic, selection and monitoring the action of therapy for particular cancer; develop a critical and analytical approach to create new research thinking and research collaboration.

**Alelopatija i alelopatski spjevi / Allelopathy and allelopathic compounds**

**Prof. dr. Erna Karalija**

The course includes aspects of allelopathic interactions between plants individually and plant communities. Students are going to be able to identify specific allelopathic interactions and to learn about different compounds included into plant to plant communication.

**Regulacija razvića biljaka /Plant growth regulation**

**Prof. dr. Erna Karalija**

Subject includes specific developmental pathways and cues that enable plants survival in ever changing environment. Students will learn about regulation of plant development from seedling to adult plant and regarding the ability of plants to “read” environmental inputs and respond adequately to changing conditions.

**Biljne interakcije i životne adaptacije / Plant interactions and life adaptations**

**Prof. dr. Erna Karalija**

The course includes response of plants for biotic stress including adaptations to avoid herbivores, nematodes and parasites but also symbiotic relations to microbes and fungi. The students will learn how recognise defensive strategies of plants including defensive colouration, mimicry and other adaptations.

**Molekularna biologija biljaka / Molecular plant biology**

**Prof. dr. Erna Karalija**

Subject includes all molecular aspects of plant development and responses to the environmental cues. Students will learn which molecules are included in major developmental paths and how plant changes synthesis/degradation of these molecules as a response to developmental signals, biotic and abiotic stress.

**MATEMATIKA**

**Diferentne jednadžbe i diskretni dinamički sistemi / Difference Equations and Discrete Dynamical Systems**

**Prof. dr. Senada Kalabušić**

The course include: Dynamics of first order difference equations; Linear difference equations of higher order; Systems of linear difference equations; The Z-transform method. On completion of the course, the student should be able to: explain the basic concept of difference equations; explain the meaning of the solutions of a difference equations; solve first order and higher order difference equations; solve the system of linear difference equations with constant coefficients; find equilibrium and periodic solutions to autonomous scalar or planar difference equations, and investigate their stability properties; analyze difference equations models by using computational and analytic tools; find and classify by type the bifurcation points of difference equations models; use computer simulations to prove or disprove conjectures or claims about difference equations; explain basic properties of the Z- transform; apply the Z-transform in finding the solutions of the linear difference equations; apply difference equations in some real world problems.

**Diferencijalne jednadžbe / Differential Equations**

**Prof. dr. Senada Kalabušić**

The course include: First order differential equations; Higher order differential equations; Systems of differential equations; The Laplace transform. On completion of the course, the student should be able to: explain the basic concept of differential equations; explain the meaning of the solutions of a differential equations; express and explain the existence and uniqueness theorems; solve first order and higher order differential equations; solve the system of linear differential equations in normal form; explain basic properties of the Laplace transform; to apply the Laplace transform in finding the solutions of the linear differential equations; apply differential equations in some real world problems.

**FIZIKA**

**Obrada podataka i modeliranje u fizici / Data processing and modeling in physics**

**Prof. dr. Azra Gazibegović Busuladžić**

The aim of the course is to teach the student to analyze and process physical data and numerically simulate physical processes. After mastering the course, student use suitable program packages for statistical data processing; conduct correlation and regression analysis; choose a suitable statistical hypothesis and test it. Student use Monte Carlo simulation and other subroutine packages to simulate physical processes.

More information on: <http://www.pmf.unsa.ba/fizika/images/npp/NPP%20FIZIKA%20II%20%20ENG.pdf>

**Fourier optika / Fourier optics**

**Prof. dr. Azra Gazibegović Busuladžić**

The aim of the course is to familiarize students with Fourier optics, its application and some specific problems. A student who master the course applies a two-dimensional discrete fourier transform to solve problems in optics; understands the resolution of problems associated with diffraction and propagation of light; knows the methods of optical system analysis.

More information on: <http://www.pmf.unsa.ba/fizika/images/npp/NPP%20FIZIKA%20II%20%20ENG.pdf>

**Metodologija naučnog istraživanja u fizici / Methodology of scientific research in physic**

**Prof. dr. Dejan Milošević**

In this subject we consider the following themes:

Why and how to perform the research in physics. Scientific procedure, difficulties in engaging in scientific research work in physics. Preparations before research, research design, sample, hypothesis. Types of scientific research by level and purpose, research projects, preliminary research. Statistics in physics research, summarizing and presentation of the results, and choice of statistical methods. Basic information on scientific writing. Categorization of publications. Authorship and co-authorship. Preparing to write a publication, write a review, write a professional article, send a manuscript to a journal, respond to an editor's decision.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Napredna kvantna mehanika /Advanced quantum mechanics**

**Prof. dr. Dejan Milošević**

In this subject the following themes are considered:

Fundamentals of quantum mechanics. Postulates of quantum mechanics. Dynamics of quantum mechanics. The uncertainty relation.The two-particle problem. Galileo's transformations. Angular momentum theory. Discrete, dynamical and internal symmetries. Identical particles. Approximations in quantum mechanics. Second quantization. Scattering theory. Path-integral method. Relativistic quantum mechanics.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Integrali po trajektorijima i semiklasična fizika / Integrals by trajectories and semiclassical physics**

**Prof. dr. Dejan Milošević**

In this subject the following themes are considered:

Basics of integrals by trajectories and solutions to simple problems. Semiclassical temporal evolution. Semiclassical trace formula. Gutzwiller formula for isolated orbits. Selected problems and applications.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Napredna statististička fitika / Advanced statistical physics**

**Prof. dr. Aner Čerkić**

Aims of the course

Aim of the course is expanding the knowledge that students have acquired in the course of statistical physics.

Specific tasks of the course

Mastering the knowledge and mathematical apparatus of quantum statistical physics. Getting acquainted with various applications of quantum statistical physics.

Syllabus

Equilibrium quantum statistics. Quantum mechanical formalism in Dirac notation. Basic concepts of quantum statistics. Basic results of the equilibrium quantum statistics. Ideal gas of quantum objects. Non-equilibrium statistical operator. Linear response of the system and Green function. Energy and entropy of a non-equilibrium ensemble. Second quantisation and Wick’s theorem. Phonons and Debye theory of specific heat capacity. Ferromagnetic materials at low and high temperatures. Kinematic levels in optically excited systems. Micro theory of the dielectric constant. Superfluidity. Superconductivity.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Kvantna teorija sudara / Quantum collision theory**

**Prof. dr. Aner Čerkić, Prof. dr. Hedim Osmanović**

Aims of the course

Expanding the knowledge of non-relativistic quantum collision theory.

Specific tasks of the course

Training students in solving complex problems of non-relativistic quantum collision theory.

Syllabus

Mathematical fundamentals. Scattering operator for a single particle. Cross sections and S-matrix. Scattering of the zero-spin and non-zero-spin particles. Invariance principles and conservation laws. Green operator and T-matrix. Born series. Stationary states in the scattering process. Resonances. Dispersion relations and complex angular momenta. Multichannel scattering: scattering operator, cross sections, invariance principles and stationary wave functions. Multichannel resonances. Scattering of identical particles.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Fizika atoma i jona / Physics of atoms and ions**

**Prof. dr. Azra Gazibegović-Busuladžić, Prof. dr. Aner Čerkić**

Course introduce students to physics of atoms and ions, quantum mechanics description of hydrogen-like atoms and multielectron atoms and ions. Student are going to master terms and quantum mechanical apparatus of physics of atoms and ions. Student‘s succes is graded from homework, seminar paper and final exam. <http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Kompjutaciona fizika / Computational physics**

**Prof. dr. Azra Gazibegović – Busuladžić, Prof. dr. Elvedin Hasović**

 The objective of the course is that student acquire competences in numerical methods and their application in modeling various physical systems. Each project assignment consists of modeling and solving some of the physical problems that students have already encountered in the courses of classical mechanics, quantum physics, and statistical physics. Student‘s succes is graded from homework, research project and final exam.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>

**Molekule u laserskom polju / Molecules in the laser field**

**Prof. dr. Mustafa Busuladžić, Prof. dr. Elvedin Hasović, Prof. dr. Senad Odžak**

Course introduce students to important concepts in the interaction of molecular systems and a strong laser field. Student will become familiar with the quantum-mechanical models by which we describe the mentioned interactions. Student is going to master the concepts and mathematical apparatus of strong-field molecular approximation and molecular low-frequency approximation. Student‘s succes is graded from homework, seminar paper and final exam.

<http://www.pmf.unsa.ba/fizika/index.php/bs/treci-ciklus>