UNDERGRADUATE STUDY PROGRAMME, 1ST BOLOGNA CYCLE
CONSERVATION BIOLOGY (BI-18)

COURSE DESCRIPTIONS

COMPULSORY COURSES

COMPULSORY COURSES OF THE 1ST YEAR OF STUDY

Course name: **GENERAL BOTANIY**
Number of ECTS credits: **6**

Content:
During the course, the students will become acquainted with the basic structure of the plant organism at the level of macromolecules, subcellular microstructures, cells, tissues and the whole organism. Emphasis will also be placed on the adaptations of plants living in different environments both at the cellular, anatomical and morphological level and on interactions between plants and other organisms. Students will gain knowledge about the basic principles and forms of reproduction. The course will focus on delivering the basic knowledge needed to understand the contents of other related subjects. The course is adapted to a relatively wide range of students of other study programmes in the field of science.

Main issues:

Cytology - the science of cell

- The cell as the basic building block of life (comparison between eucaryotic and procaryotic cell, size and shape of plant cells, the importance of the organization of plant cells, the typical plant cell structure, comparison between plant and animal cell).
- Protoplasm (physical-chemical properties of protoplasm, the basic molecular structure of the plasma cell membrane and transport, cytoplasmic membrane organelles, ribosomes, cytoskeleton).
- Structure of major cellular organelles (cell nucleus and division, plastids, mitochondria).
- Endosymbiotic theory and the origin of eukaryotes.
- Products extracting the protoplast (vacuoles and their contents, proteins and other crystals, carbohydrates, cell wall).

Histology - the science of tissues

- Meristematic tissues (apical meristems, secondary meristems, meristemoids)
- Permanent tissue (formation and different types intercellular spaces, parenchyma, dermal tissues, mechanic tissues, conductive tissues,secretory tissues)

Morphology
Stem

- external and internal organisation of stems
- stem growth and differentiation

Leaves

- external and internal structure of foliage leaves
- morphology and anatomy of other leaf types

Roots

- structure of roots and root systems
- development of lateral roots
- root modifications
- symbyosis with fungi (mycorrhizae) and N_2-fixing bacteria

Secondary growth of plants

- vascular cambium
- secondary xylem
- secondary phloem
- outer bark
- anomalous secondary growth

Flowers and Reproduction

- asexual reproduction
- sexual reproduction
- flower structure and pollination (anemophily, zoophily, entomophily...)
- fruit types and dispersal (anemochory, hidrochory, zoochory, entomochory, myrmecochory...)

Course name: **GENERAL ZOOLOGY**
Number of ECTS credits: **9**

Content:
The course is an introduction to zoology, which gives a fundamental understanding of the structure and function of animals within wider context of evolution of biological systems. Students are introduced to the principles of biology and theoretical basis for defining species, to the basic of Darwin-Wallace theory of evolution, and to the theory on the origin of life. They learn about the structure of animals through the basic levels of biological organization including cytology, histology, morphology and organography.
The focus of the course focuses on phylogenetic classification,evolution and comparative anatomy of animals presented through the main taxonomic groups (phyla). Students are introduced to the history of biological classification, principles of zoological nomenclature and basics of animal systematic presented in an evolutionary context, with emphasis on the understanding of animal body plans (body symmetry), development of germ layers, body cavities and embryonic development. Through this course student will be trained in critical and integrative assessment of biological systems, which are perceived as hypothesis rather than a fact. The course also includes visiting lecture of an invited expert in certain field of zoology, and discussion/ synthesis of the knowledge obtained through this course.

Main Themes:
- principles of biology, functional and structural characteristics of biological systems
- origin of life; organic evolution, evolution of cell and multicellular organisms
- Darwin – Wallace theory of evolution; mikroevoltion and macroevolution
- theory of species; classification and systematic of animals
- cytology, histology, organography and morphology of animals
- reproduction and ontogeny of animals
- introduction animal ecology and ethology

The program of the course is given in the form of a handout (*syllabus*), available in electronic form on the website. Literature is available in the library.

Course name: **GENERAL AND INORGANIC CHEMISTRY**
Number of ECTS credits: **6**

Content:
The short summary of material changes and chemical laws will be given at the beginning of course. Followed by the explanation of basic chemical concepts: atom, molecule, ion, element, compound, pure substance, mixture, formulas, etc.
In chapters dealing with the amount of substance, relative atomic and molecular weight, and molecular weight the basics tutorial will be given.
Field structure of atoms and chemical bonds will focus on the importance of chemical bonds within the molecules and atoms of the building and the periodic table of elements. A basic overview of dispersion systems and balancing chemical reactions inside will be introduced. The overview of inorganic compounds will be taken according to the periodic table of elements, and organic functional groups.The subject will be based primarily on the acquisition of fundamental knowledge of chemistry necessary to understand the content of other chemical items and adjusted relatively wide range of students of other courses in the field of science.

Main issues**:**

- *Materials and material change and energy*
- *Chemical laws*
  - The law of conservation of mass in chemical reactions
  - Act on permanent and act as multiple mass ratio
- *Basics concepts*
  - Atom, molecule, ion
  - Element, compound, pure substance, mixture
  - Formulas and names of substances
- *The amount of chemical substances*
  - The amount of substance
  - Atomic and molecular mass
  - Molar mass
- *Electronic structure of atoms and the periodic table of elements*
- *Atomic bonds:*
  - Ionic bond
  - Covalent bond
  - Metal bond
- *Molecular bond and physical states*
- *Disperse Systems*
  - The right solution
  - Colloid solutions
  - Concentration of solutions
  - Solubility
  - Colligative properties
- *Chemical equilibrium*
  - Electrolytes and Protolithic reaction
  - Acids and bases
  - Hydrolysis
  - Titration
  - Buffers and pH
- *Oxidation and reduction reactions*
- A *brief overview of inorganic compounds*
  - Covalent compounds
  - Ionic compounds with major anions
- *A brief overview of organic compounds (functional groups)*
- *Environmental chemistry*
  - Ozone depletion
  - Acid rain

Course name: **MATHEMATICS**
Number of ECTS credits: **6**

Content:
- Sets. Natural numbers. Rational numbers. Real numbers. Complex numbers.
- Functions. Bijective functions and inverse.
- Sequences of real numbers. Limit and accumulation points. Monotone sequences. Bolzano-Weierstrass theorem.
- Functions of one variable. Odd and even functions, periodic functions. Left and right limit. Continuity. Method ob bisection. Elementary functions. Cyclometric functions.
- Differential calculus. Rules of differentiation. Lagrange theorem. Finding extrema of functions.
- Integral calculus. Indefinite and definite integral. Newton-Leibnitz formula. Applications.
- [time permiting] Vectors in R3. Vector operations. Dot, vector and mixed product. Equation of a plane and a line.

Course name: **INTRODUCTION TO COMPUTER SCIENCE**
Number of ECTS credits: **6**

Content:
The course will cover topics that might include (but are not restricted to) any of the following according to the needs and development of the subjects covered:

- Hardware.
- The structure of a computer system, the memory hierarchy, devices, bus, I/O devices, CPU. Operating system. Processes, synchronisation, devices, process scheduler, device managers.
- OS Linux basics.
- The Linux OS and its Slovenian flavour – Pingo Linux. Usage of the BASH shell.
- Programming languages.
- Programming language types. Imperative, object-oriented, logical, declarative programming languages. Concepts of programming languages. Iteration, data structures, control structures, functions, subroutines. Basic data structures: fields, arrays and lists. The C programming language.
- The object oriented model.
- The concepts of the object oriented model: objects, classes, fields, methods, inheritance, polymorphism, multiple inheritance, interfaces and abstract classes. Abstract data types. Examples of abstract data types. The Java programming language.

Course name: **FOUNDATIONS OF PHYSICS WITH BIOPHYSICS**
Number of ECTS credits: **6**

Content:
The course introduces basic concepts of physics which are essential for the understanding of the processes present in living organisms. The importance of these concepts is illustrated by their use in the explanation of specific cases.

Principal general themes of pysical fundamentals:
- Intensive and extensive (additive) physical quantities and operation procedures in the measuring of these quantities (added to the basic ones will be the concept of density, pressure, concentration, temperature, potential, conductivity, optical properties, …)
- Forms of energy (kinetic, potential, elastic, internal, chemical, electrical,...) and methods for increasing, decreasing and changing of energies (work, heat).
- Matter, electrical and heat flows and conservation laws.
- Oscillations and waves (mechanical and electromagnetic), and phenomena related to oscillations (reflection, refraction, interference).

More detailed themes of biophysical applications:
- Biomechanics (levers in the human body, biomechanics of human limbs, torsion deformations, body stability).
- Differences in pressure and concentration as a cause for matter flows (flows in plants, arteries and heart, exchange of gasses, osmosis processes).
- Temperature differences as a cause of heat flows (fundamentals of processes in living creatures with varying and fixed body temperatures, sources of energy and energy transformation).
- Differences of potential as a cause of electrical currents (a cell as the battery of electrochemical energy: the passing of matter through the cell membrane, action potential, electric field in a cell, passive and active electrical properties of the cell membranes).
- Vocal chords as a transmitter of sound and the biophysical image of the ear as a sound receptor.
- Optical instruments (camera, projector, microscope, and the eye as a light receptor).
- Basics of the molecular biophysics (properties of the basic components of biological systems and connections between them.

Course name: **PLANT PHYSIOLOGY**
Number of ECTS credits: **6**

Content:
- Water balance of plants. Water absorption, transport and transpiration. Water status of the plant.
- Mineral nutrition. Macro- and microelements in the soil, availability and concentration of nutrients in the rhizosphere, absorption into roots (soil pH effect). Mechanisms of absorption in plant cell (permeability of membranes, membrane transport mechanisms, primary and secondary active transport). Short distance transport. Xylem and phloem transport and regulation. Mineral nutrition and plant growth and development. The role of symbiosis (mycorrhizas and nitrogen fixation) in plant mineral nutrition and other benefits of symbioses. Rhizosphere.
- Photosynthesis. Light and carbon reactions. Assimilate transport (chloroplasts to cytosol). Sucrose and primary starch synthesis. C3, C4, and CAM metabolism. Energy efficiency of photosynthesis. Measurements of photosynthesis. Impact of environmental factors on photosynthesis. Interaction with other organisms and importance of the primary production for ecosystems.
- Photorespiration. Processes and importance.
- Respiration. Respiratory steps: glycolysis, Krebs cycle, electron transport system, oxidative phosphorylation. Respiration in plants (cyanide resistant respiration) and comparison with respiration of other organisms.
- Synthesis and catabolism of fatty acids.
- Nitrogen and sulphur assimilation. Assimilation and transport of ammonium nitrate and sulphur. Integration in organic compounds.
- Secondary metabolites. Terpenes, phenolic compounds, tannins, alcaloides, nitrogen-containing compounds and their importance in the interactions with other organisms. Allelopathy.
- Growth and development. Plant blue and red light responses. Impact of environmental factors on plant growth and development.
- Plant hormones. The role of plant hormones (auxins, cytokinins, gibberellins, abscisins, ethylene) and other growth regulators (jasmonic acid, salicylic acid, strigolactones). Growth regulators and interactions with other organisms.
- Physiology of plant movement. Basics of signal transduction. Tropism, nastic movements, taxis. Response to light and gravity. Chemical influences. Mechanical stimuli.
- Plant interaction with its environment and stress response.

Course name: **ANIMAL PHYSIOLOGY**
Number of ECTS credits: **6**

Content:
Students will learn about the functions of cells (processes of the cellular physiology), tissues, organs and organ systems, as well as some aspects of the homeostatic regulatory mechanisms, feedback systems, biorhythms and adaptations. A good part of the attention will be dedicated to activity of

nervous system: basic principles of excitability, manner of translation of nervous signals through axons and types and activity of synapses. Separately will be considered receptor cells and molecular mechanisms of translation of stimuli from environment to nervous activity. As upgrade of activity of individual neurons students will comprehend their connections in nervous networks and relations between activity of nervous system and animal behavior.
As manner of communication between different parts of the body, except for nervous system, are in multicellular animals important also chemical transmitters. Students will be introduced with activity of endocrine cells/glands and with effects, that their secretions have on the target cells. They will get to know secondary messengers, that transmit chemical signals within interior of cells.
Mobility is among more noticeable features of the animals. The object of discussion will be characteristics of muscle cells and regulation of muscular tissue activity. Students will also learn about motion of cells, either single-cell organisms or individual cells of multicellular organisms.
How tissues and cells are supplied with nutrients and oxygen, and how they abolish waste substances, will be treated in four mutually connected assemblies: the blood circulation , exchange of gases, absorption of nutrients and excretion. Different types of cardiovascular system and their activity will be introduced (function of heart, dynamic of blood flow, role of vascular system). The exchange of gases with surroundings, special adaptations to characteristics of land and water environment will be considered. The same applies also to the problems of osmoregulation and secretion of digestive products.

Nutrition: Although every animal species has its own nutritive demand, all animals must decompose food into basic elements, that use them as energy source and as components for growth and regeneration of tissues. Food chains and trophic levels. Producers and consumers.
Animals energy gained with food partially use for maintenance of stabile inner environment, which includes also thermoregulation. Some frequent modes for keeping the appropriate body temperatures (endothermic, exothermic animals), will be introduced.
Course program includes also the animal behavior, animal orientation (animal navigation) and physiology of reproduction. Microbial impact on animal behavior.

Course name: **INTRODUCTION TO MICROBIOLOGY**
Number of ECTS credits: **3**

Content:
Students become acquainted with microbiology as a scientific discipline and a profession. At the same time students learn the basic principles of scientific thinking, and identification and evaluation of the new knowledge.

The course is divided into the following sections:

1) Introduction to microbiology and its historical development.
2) Microbial groups and their basic characteristics (structure and cell function).
3) Microbial metabolism and growth.
4) Molecular biology and gene expression in microorganisms (archaea, bacteria, eukaryotes).
5) Introduction to virology, microbial genetics and genomics.
6) Introduction to microbial ecology.

COMPULSORY COURSES OF THE 2ND YEAR OF STUDY

Course name: **SISTEMATIC ZOOLOGY**
Number of ECTS credits: **9**

Content:
The course is based on phylogenetic classification of animals. Students get familiar with the history of classification and its principles as well as basics of zoological nomenclature and cladistics. They also get familiar with different approaches in classification, e.g. with morphological and molecular classification. Basic definitions of species are also given. Special stress is given upon the evolution not

only memorizing the taxonomic categories. Crucial problems of construction of taxonomic and phylogenetic systems are also given, e.g. through interpretation of fossils.

Main topics:
- history and classification,
- taxonomical categories,
- zoological nomenclature,
- theory of animal species,
- invertebrate classification and phylogeny,
- chordate classification and phylogeny.

Course name: **INTRODUCTION TO GENETICS AND GENOMICS**
Number of ECTS credits: **6**

Content:
- Fundamentals of transmission genetics: lows of inheritance, pedigree analysis of inheritance of dominant and recessive genes, molecular basics of dominant and recessive mutations.
- Avtosomal and sex linked inheritance.
- Cytoplasmic inheritance.
- Human genome organization.
- Genome mapping, techniques of mapping, genetic and physical approaches, PCR technique, Southern, Northern detection, DNA markers (RFLP, VNTR, SSR, SNP, EST, AFLP…), fluorescent in situ hybridization (FISH), mapping STS
- Restriction enzymes, separation of DNA fragments, cloning DNA vectors
- DNA recombinant techniques
- Methods for sequencing DNA, understanding and importance of genomic projects
- Analysis of genes, reverse genetics, methods for analysis of expressed sequences
- Morphology and structure elements of Eukaryote chromosome: telomere, centromere, role, replication model of telomere, organization of DNA on the chromosome, construction of chromatin, heterochromatin
- Organization of Eukaryote genome
- Genes and organization of genes
- Organel genomes, evolution and properties
- The path from DNA to protein
- Expression of genes: initiation of transcription, the role of chromatin, the role of RNA polymerases, regulation of transcription in prokaryotes and eukaryotes, positive and negative regulation of expression of genes.
- Synthesis and processing of different RNA molecules
- Modification of genetic material, mutations on the chromosome, gene, genome. The causes of mutations, the impact on the organism and the importance in the evolution
- Repair mechanisms
- Recombinations
- Mobile genetic elements and their role
- Evolution of genomes
- Population genetics: genetic variability and changes in populations, genetic distances, methods for estimation of genetic variability and distances, molecular markers for population genetic studies
- Application of genomics

Course name: **STATISTICS**
Number of ECTS credits: **6**

Content:
- Introduction. What is statistics? Examples of applications of statistical methods in natural sciences. Population. Sample.
- Random variables. Continuous and discrete random variables. Examples of random variables. Probability function, probability density function, cumulative distribution function.

- Descriptive statistics. Frequency distribution. Measures of central tendency. Quantiles. Measures of variability.
- Sampling. Introductory examples. Random sampling. Sampling distribution. Standard error. Confidence intervals.
- Graphical methods of data representation. Histogram. Scatter plots. Box and whisker plot. QQ-diagram.
- Hypothesis testing. Null hypothesis, alternative hypothesis. Errors in hypothesis testing.
- Correlation and dependence. Regression. Linear regression. Measures of linear dependence. Correlation coefficients. Non-linear dependencies. Association, contingency tables.

Course name: **ORGANIC CHEMISTRY AND BIOCHEMISTRY**
Number of ECTS credits: **6**

Content:
Organic chemistry:
- Importance and role of organic chemistry
- Structural characteristics of organic compounds
- Nucleophilic reactions
- Radical reaction
- Oxidations
- Reductions
- Carbohydrates
- Amino acids, peptides and proteins
- Isolation of organic compounds

Biochemistry:
- Principles of biochemistry
- Structure and function of biomolecules and catalysis
- Bioenergetics and metabolism (catabolism and anabolism)

Course name: **BIODIVERSITY**
Number of ECTS credits: **6**

Content:
This course introduces the theory of biodiversity science and provides an overview of the current knowledge about the diversity. The course provides the students with knowledge and practical skills for biodiversity assessment across different levels of biological organization and environments. By combining both fundamentals of the subject and state of the art knowledge, the course explores concepts of biodiversity in time and space on various levels from molecules to ecosystems. Students will get acknowledged with field and laboratory techniques of biodiversity assessments and gain knowledge on basic concepts of biodiversity conservation.

Theory of biodiversity science
- Biodiversity: concept, history
- Elements of biodiversity: genetic diversity (genes → populations); organismal diversity (individuals → domains/kingdoms); ecological diversity (populations → biomes)
- Biodiversity through time: Sources of information, History of biodiversity, Extinctions
- Biodiversity in space: gradients shaping biodiversity in terrestrial and aquatic systems; α-, β-, γ-diversity; global biodiversity patterns
- Biodiversity and ecological networks
- Direct and indirect-use values of biodiversity, biodiversity as value
- Human impacts on biodiversity

Measuring and mapping biodiversity
- Issues of scale in biodiversity studies
- Community diversity and biotic inventories

- Sampling techniques in biodiversity studies in terrestrial and aquatic ecosystems
- Richness and evenness; community diversity indices
- α-, β- and γ- diversity indices
- Rapid biodiversity assessment methods
- Interpetation and prioritization of biodiversity data

Course name: **SYSTEMATIC BOTANY AND GEOBOTANY**
Number of ECTS credits: **9**

Content:
Students will be acquainted with evolutionary processes in the world of vascular plants, its biodiversity and relationships between plant taxa of different ranks. He will be introduced with basic patterns of biodiversity on various levels from molecules to ecosystems and evolutionary processes resulting in creation of different plant taxa. The course will provide the basis for an introduction to the morphology, evolution, and classification of land plants. A foundation of the approach, methods, research goals, evidence, and terminology of plant systematics will be presented along with the most recent knowledge of evolutionary relationships of plants and practical information vital to the field. Course will be flexible enough an suitable even for the listeners of other study fields both within natural sciences and some social sciences (e.g., Geography).

Major subjects:

Plant Systematics
- The Science of Plant Systematics
- Methods and Principles of Biological Systematics (phylogeny, historical evolutionary traits, practical examples in evolution)
- Historical Background
- Taxonomic Evidence: Structural and Biochemical Characters (morphology, pollination biology, flower, fruit and seed types, anatomy, embriology, chromosomes, palinology, secondary metabolites, proteins)
- Molecular Systematics
- An Overview of Green Plant Phylogeny
- Relationships of Angiosperms
- Botanical Nomenclature
- Specimen Preparation and Identification
- Flora of Slovenia (diversity, specifics, conservation)

Geobotany
- Geobotany disciplines
- Phytosociology in the frame of geobotany
- Plant association: a basic category in plant sociology
- Sinmorphology
- Methods in plant sociology
- Phytosociological data
- Syntaxonomy: synoptic features of the syntaxa, basic characteristics of the sigmatistic system, higher ranked syntaxa
- Multivariate data analyses in phytosociology (ordination, indirect and direct gradient analysis, principal component methods, numerical sintaksonomy
- Syndynamics, synchronology and symphenology (methods in study of successions and fluctuations in vegetation)
- Sinchorology (arealology, floral elements, vegetation maps)

Course name: **STUDY PRACTISE WITH BASIC IN RESEARCH METODOLOGY**
Number of ECTS credits: **6**

Content:
Students of the 2nd year have to carry out a compulsory teaching practice evaluated with 6 ECTS that lasts 3 weeks (150 hours). The purpose of the study practice is to transfer theoretical knowledge of students into practical by under the supervision of staff of various companies and public services, such as research institutions, non-governmental and governmental organizations, which operate under the protection of nature and the environment. As a result of the work the students prepare a report on the practice.
To this end, students are pre-qualified. Students are given basic knowledge and tools for understanding, planning and conduct research in the life sciences and to present its findings in written and oral communication. The course represents an introduction to the research process that involves conceptualization, information search, evaluation and analysis of the results, report writing, and presentation. It deals with the topic of the research plan, including issues of validity, reliability, accuracy and scientific ethics.

COMPULSORY COURSES OF THE 3RD YEAR OF STUDY

Course name: **ECOLOGY**
Number of ECTS credits: **9**

Content:
Basic principles of ecology; Organism and its adaptation to the environment (autecology; ecological factors); Population ecology (population parameters, dispersion, natality and mortality, age and sex structure, population growth and regulation, population fluctuations); Intraspecific relations (ecological niche, predation, competition, parasitism, mutualism); Ecosystem ecology (definition, ecosystem structure, circulation of matter and energy flow, succession, climax, global ecosystems, exploitation of ecosystems).
Fundamental characteristics of aquatic ecosystems; Energy inputs in aquatic ecosystems and functioning of food webs in aquatic ecosystems; Types and ecological characteristics of aquatic ecosystems; Role and importance of aquatic ecosystem.

Course name: **EVOLUTIONARY BIOLOGY**
Number of ECTS credits: **6**

Content:
Historical development of evolutionary thought before and after Darwin-Wallace theory; Definition of life; Spontaneous variability (mutations - molecular variability and its significance for evolution); Natural selection; Evolution and biogeography; Evolution and speciation; Biological species concept; Evolution through time (with basics of palaeontology); Origin and evolution of genus *Homo*; Origin of life; Creationism and evolutionism.

Course name: **APPLIED MATHEMATICS IN NATURAL SCIENCE**
Number of ECTS credits: **6**

Content:
- Linear algebra:
  - Matrices and basic operations with matrices. Determinant. Rank. Transpose of a matrix. Inverse.
  - Systems of linear equations.
  - Eigenvalues and eigenvectors.
  - Matrices in natural sciences.

- Functions of several variables. Continuity and differentiability. Extrema of functions of several variables.
- Differential equations. Equations with separable variables. Linear differential equations.

Course name: **CONSERVATION BIOLOGY**
Number of ECTS credits: **9**

Content:
The course is primary dedicated to introduction of biodiversity crisis and conservation biology which represents an upgrade to the classic nature conservation. The syllabus od the course includes review of the history of conservation efforts, reasons for the emergence of conservation biology, ethical basis for conservation and its importance. Course also presents importance of diversity in global and local range, different threats to biodiversity and the importance of fragmentation, ecology dynamics, demography and genetics of small populations.

Visiting teacher lecture - discussion and synthesis of one of these topics.

Main topics:
- Emergence of conservation biology
- Principles of conservation biology
- Biodiversity crisis – its extent and causes
- Biodiversity - its range and distribution
- Levels of biodiversity (genetic, species, ecosystem level)
- Importance of species in conservation biology
- Genetics of small populations
- Fragmentation
- Demography of endangered populations
- Ecology dynamics
- Conservation measures: *in situ* & *ex situ* conservation
- National legislation and intenational conventions in nature conservation
- Human dimension of conservation

Course name: **BIOGEOGRAPHY**
Number of ECTS credits: **6**

Content:
Basic principles of biogeography, environment and history (distribution of species, distribution of communities, dynamic biogeography, glaciation and biogeographical dynamics in the Pleistocene); Historical patterns and processes (speciation and extinction; dispersion; endemism and provincialism; phylogeography); Recent patterns and processes (island biogeography, species and ecosystem diversity); Historical vs. ecological biogeography, Biogeographic regions; Biogeography and conservation biology.

Course name: **PROTECTED AREAS AND SUSTAINABLE USE**
Number of ECTS credits: **6**

Content:
Protection of environment vs. Conservation of nature, basic definitions. Historical development of Protected Areas. Eco- vs. Anthropocentric ethics, Protected Area paradigms.
Determination of natural features of special importance.
International system of Protected Area categories.
System of nature conservation in Slovenia: an introduction.
Protected Areas in Slovenia and Natura 2000 network.
Pressures and threats to Protected Areas.
Management of Protected Areas.

Governance of Protected Areas.
Sustainable use of natural values in Protected Areas.
International institutions, agreements and Protected Area policies.

ELECTIVE COURSES

Course name: **BIODIVERSITY AND ECOLOGY OF THE MEDITERRANEAN**
Number of ECTS credits: **6**

Content:
Course focuses on general principles of ecology (abiotic factors, inter/intra species relationships, successions...) and biodiversity of the area while pinpointing general problems of the respective ecology, like biological invasions, global warming, loss of biodiversity, desertification, renaturation of degradated environment. Students will be acquainted with (palaeo)climatic peculiarities, geology and relief of the Mediterranean basin, its unique biodiversity and human impact on Mediterranean landscape in past and present. An importan part of the course will be given to plant ecology and anatomical, chemical and functional adaptations on specific Mediterranean environment. Inter/intra species interactions (competition, parasitism, herbivory...) will be analyzed in the light of Mediterranean ecology. Special emphasis will be given to the Mediterranean as a biodiversity hotspot: students will be aquainted with causes and consequences of Mediterranean biodiversity ([palaeo]ecological and geological diversity, impact of early human colonization...) and its threats: landscape degradation, pollution, global changes, invasions, urbanism, fire, desertification...). Biodiversity of the Mediterranean will be discussed on several levels from molecules (contemporary techniques) to ecosystems.

Major subjects:
- Mediterranean ecosystem Worldwide
- Physical environment of the Mediterranean basin
- Life forms and functional adaptations
- Inter/intra species interactions
- Disturbation and successions in Mediterranean plant communities
- Agricultural ecosystem in Mediterranean: domestification, center of crop gene diversity
- Mediterranean biodiversity
- Monitoring and preservation of biodiversity
- Changes in Mediterranean ecosystem Worldwide
- Basic characteristics of conservation of nature and environment in the Mediterranean

Course name: **MARINE BIODIVERSITY**
Number of ECTS credits: **6**

Content:
The course includes the following topics:
- Basic definition terms from the topics of biodiversity, Geography of the seas and Marine, Historical and recent biogeography.
- Benthic bionomy:
  - *Supralittoral biocoenose,*
  - *Mediolittoral biocoenoses,*
  - *Infralittoral biocoenoses,*
  - *Circalittoral biocoenoses.*
- Spatial and temporal changes of marine biodiversity *(Wegener's continental drift theory, Tethys, local, global and mass extinctions, Permian crysis, Messinian crysis, the origin of Mediterranean biodiversity)*
- The survey of the marine biodiversity
- The survey of Mediterranean and Adriatic marine biodiversity
- Marine natural resources
- Marine bioconstruction

- *Definitions (ecological niche, spatial heterogeneity, ecological relationships)*
- *Bioconstruction (coral reefs, coralligenous algae, other animal groups)*
- *Bioerosion (endolihic species, mechanical digging, chemical digging)*
- *The rule and importance of bioconstructors wiuth special reference to coral reefs*

▪ Marine biodiversity crysis
- *Habitat degradation and habitat loss ecosystems*
- *Bioinvasion (Lessepsian migrants, ballast waters, introduction with mariculture, escapes)*
- *Oceanographical and climate change (tropicalisation)*
- *Nonsustainable use of nature resources whaling, fishery, bycatch, intensive, semiintensive and extensive aquaculture)*
- *Marine pollution (bioaccumulation, biomagnification,other aspects)*

▪ Marine biodiversity conservation
- *Active principles (artificial reefs, FAD)*
- *Passive principles (MPA, methodology)*

▪ Marine biodiversity of Slovenian sea
- *How many species in Slovenian sea?*
- *Bionomic and biogeographic peculiarities of Slovenian sea*
- *Marine protected areas in Slovenia*

Course name: **BIOLOGY AND DIVERSITY OF VERTEBRATES**
Number of ECTS credits: **6**

Content:
Phylogeny and classification of Chordata is presented. First, students get familiar with evolutionary origin of the Vertebrata and are able to recognise sinapomorphies of their main monophyletic groups, that in Vertebrata are mainly not in concordance with traditional systematics (i.e. Pisces, Amphibia, Reptilia, Aves, Mammalia). In that way students are able to approach critically to systematic zoology that is changing all the time. The importance of key fossils that show specific stages in evolution of vertebrates or evolved new apomorphies of certain groups are stressed. Important topics are evolution of Tetrapoda, origin of terrestrial life and evolution of Amniota. Evolution of Sinapsida and causes for their radiation and diversity are stressed. Paralel to each group discussed, their typical representatives (in lectures and laboratory work) from throughout the world are presented.

Main topics:
- Sinapomorphies of Chordata
- Origin of Chordata, hypotheses
- Tunicata: biology, diversity, evolution
- Possible explanations for evolution of vertebrates, sinapomorphies
- The oldest fossils – datations and importance (*Pikaia*, Conodonta, Ostracoderma)
- Evolutionary origin of jaws and of Gnathostomata (Placodermi, Acanthodii, Chodrichties, Osteichtyes)
- Evolutionary origin of Tetrapods and transition from aquatic to terrestrial way of life
- Origin of tetrapods' limbs, HOX genes
- Phylogenetic relationships within Sarcopterigians
- First tetrapods
- Sinapsida, Anapsida, Diapsida: evolution
- Radiation and decline of dinosaurs
- Sinapsida and evolution of mammals
- Biogeographical patterns
- Evolution of birds, flight

Course name: **BIOLOGICAL TOPICS IN ENGLISH**
Number of ECTS credits: **6**

Content:
Lectures will cover the most important and up-to-date research topics from Biology, which could encompass the following fields:
- Basic Zoology
- Basic Botany
- Biology and human anatomy
- Physiology of animals
- Physiology of plants
- Genetics
- Biochemistry
- Cell Biology
- Molecular Biology
- Evolution
- Ecology and conservation biology
- Ethology

Course name: **ECOTOXICOLOGY**
Number of ECTS credits: **6**

Content:
The ecotoxicology and methods, which enable the assessment of the risk for the environment when chemicals are used, will be presented.
It is assumed that students have the basic knowledge on ecology.
The knowledge on toxicology will be limited to the basic principles and methods. The major routes of chemical intake into organisms, their distribution in different tissues, their metabolism and excretion routes will be presented. The students will get knowledge on effects of pollutants, which are visible on different forms on molecular and cellular levels. The dependence of dose on the extent of the response will be presented.
Ecotoxicology will be presented as science which is examines effects of pollutants on ecosystems. The different groups of chemicals will be presented, and their physical-chemical characteristics which determine their fate in the environment (air, water, soil) will be discussed. The probability for the accumulation in different environmental compartments, and the biodegradability will be considered, as well as the accumulation of pollutants in organisms (bioaccumulation/bioconcentration and biomagnification).
The effects of chemicals on individual organisms will be discussed in the chapter »toxicology«. The laboratory practice will include the implementation of some classical toxicity testing with organisms, such as Daphnia magna. , In addition some genotoxicity testing will be done (Allium test).
Monitoring and dhemical analitical methods are another chapter, and it includes the presentation of methods for the determination of chemicals in the environment. Biomonitoring is a determination of chemicals in living organism, and both is very important for the risk assessment studies.
Invited speakers will present specific topics.

Important topics:
- ecology,
- toxicology,
- ecotoxicology,
- chemicals and their fate in the environment,
- effects of chemicals on individual organisms,
- effects of chemicals on populations and communities,
- monitoring and chemical analysis,
- biomonitoring.

Course name: **GEOGRAPHICAL INFORMATION SCIENCE AND SYSTEMS**
Number of ECTS credits: **6**

Content:
Course content of GIS with thematic cartography consists of five main chapters, which detail below:
Fundamentals of Geographic Information Systems:
- explanation of the concept of a geographic information system,
- use of geographic information systems,
- organization of geographic information systems (hardware and software).

Spatial data:
- vector and raster data models,
- database,
- data layers.

Capture of spatial data:
- official sources of digital data
- vector and raster digitization (emphasis on topology),
- remote sensing,
- spatial data quality (accuracy of individual, data elements, the accuracy of the data set, sources of errors, or errors).

Processing of spatial data:
- conversion of data
- spatial analysis and modelling (mathematical and logical operations, the type of overlapping layers, etc..)
- Preparation of outputs.

Data visualization and spatial analysis of the results:
- mathematical elements of maps (map projections, criteria, coordinate systems),
- cartographic means of expression (cartographic signs, charts, captions)
- the creation of mapping expressions using graphic variables,
- methods of cartographic generalization.

Course name: **CRYPTOGAMIC BOTANY**
Number of ECTS credits: **6**

Content:
Students will be acquainted with evolutionary processes in the world of plants which reproduce by spores (algae, bryophytes and ferns). He will be acquainted with their biodiversity and relationships between the plant taxa of different ranks. He will be introduced with basic patterns of biodiversity on various levels from molecules to ecosystems and evolutionary processes resulting in creation of different plant taxa. The course will provide the basis for an introduction to the morphology, evolution, and classification of cryptogamic plants. A foundation of the approach, methods, research goals, evidence, and terminology of cryptogams will be presented along with the most recent knowledge of evolutionary relationships of plants and practical information vital to the field. Course will be flexible enough and suitable even for the listeners of other study fields within natural sciences.

Major subjects:
- Cryptogamic Botany – a scientific discipline
- Methods in cryptogamic botany (phylogeny, historical evolutionary traits, practical examples in evolution)
- Taxonomic Evidence: Structural and Biochemical Characters (morphology, reproductive biology, anatomy, chromosomes, secondary metabolites, proteins, DNA)
- Systematics and evolutionary lines in cryptogams
- Botanical Nomenclature
- Specimen Preparation and Identification

Course name: **METHODOLOGY AND COMMUNICATION IN BIOLOGICAL SCIENCES**
Number of ECTS credits: **6**

Content:
The course provides basic knowledge and tools for students to understand, plan and conduct research in the field of biological sciences, and to present their findings in the form of written and oral communications. The course is a prologue to the cycle of the research processes including conceptualization, information searching, evaluation, analysis, report-writing and presentation technique. It addresses underpinnings of research design, among them the issues of validity, reliability, scientific rigour and ethics.

Main topics:
- science: definition and characteristics; classification of scientific disciplines;
- the process of knowledge creation and production of scientific knowledge;
- information types in science: primary, secondary and tertiary information; evaluation of information;
- information/literature search and review; bibliographic on-line search engines;
- planning research: problem formulation and hypothesis creation, research design, scientific rigour
- sampling and data collection, data analysis and interpretation; possibilities and limitations of quantitative and qualitative research
- types of scientific communication
- principles and rules of scientific writing and self-editing
- communicating science, oral presentations.

Course name: **MICROBIAL DIVERSITY AND ECOSYSTEM SERVICES**
Number of ECTS credits: **6**

Content:
The student is introduced to microbiology and microbial ecology as a scientific discipline, also in the light of nature conservation. The student is introduced to basic principles of the scientific thinking and evaluation of new findings.
Content includes the following chapters:
- Introduction to microbiology and historical overview of the development of microbiology.
- Taxonomic groups of microorganisms and their characteristics (cell structure and cell function).
- Microbial metabolism and growth.
- Molecular biology and microbial gene expression (Archaea, Bacteria, Eucariota).
- Virology, microbial genetics and genomics.
- Evolution and microbial diversity.
- Introduction to microbial ecology (methods in microbial ecology).
- Ecosystem services.

Course name: **ENVIRONMENTAL MONITORING**
Number of ECTS credits: **6**

Content:
In the first part of the course a brief summary of the basic concepts and parameters of chemical analysis will be presented.
This will be followed by the explanation of important classical chemical techniques and evaluation of analytical results.
The main pollutants in our environment will be presented. As an important part of the environmental pollution assessment the biomonitoring will be presented; the basic principles of bioindication/biomonitoring will be presented, as well as individual case studies from Slovenia.

Main issues:
- *Analytical chemistry*

Analytical techniques (gravimetry, titrimetry - precipitation, nevtralisation, redox and complexometric titrations).
Evaluation of analytical results: random and systematic errors, precision and accuracy, measurement uncertainty
Review of basic instrumental techniques:
electrochemical, spectroscopic and chromatographic techniques, automated chemical analysis
Quality in analytical laboratories

- *Bioindication*

The introduction in the Bioindication will be done – the explanation of terms. Different types of bioindication will be presented (response, accumulative, passive, active, and retrospective). The reasons for the use of bioindication methods will be given, as well as the requirements that each taxon must meet, in order to be used as bioindicator. We will present many practical cases where studies were conducted in environmental pollution assessment with the help of bioindication, with emphasis on studies carried out in Slovenia. Among others, the results of epiphytic lichens, tree rings, and roe deer as bioindicators of environmental pollution will be presented.

As INTERNALLY ELECTIVE COURSES students can also choose the following courses from the undergraduate study programmes at UP FAMNIT:

- **Mediterranean Agriculture** (higher education professional)**:** Fishery, Agroecology, Land Use and Soil Protection, Forest and Wood Management, Nature Conservation and Sustainable Agriculture, Soil Ecology, Applied Entomology, Agrobiodiversity and Gene Banks, Soil Biodiversity and Ecosystem Services in Sustainable Agriculture, Floral Biology and Pollination Ecology;
- **Bioinformatics:** Basic Population Genetics, Evolutionary and Population Genetics;
- **Biopsichology:** Ethics and Humanity, The psychology of communication

Contents of the above mentioned courses are available in the presentation of the study programme (Course structure).