Courses in English for BSc in Environmental Sciences students offered by the Center of Environmental Studies, Eötvös Loránd University

	Courses	Acquired knowledge
Courses in Environmental Chemistry	Environmental Analitical Chemistry (BSc) 2 credits	This session describes the atmosphere, hydrosphere and lithosphere determination of anthropogenic pollutants typical for sample preparation and analytical chemistry techniques and on-line measurement methods. Students will receive an overview of spectroscopic methods commonly used in the environmental analysis, learn about the most common separation techniques, and present the special needs and the most common variants of pollution monitoring. Presented methods AAS, ICP-AES, ICP-MS, XRF, TXRF, UV-VIS, IR and FTIR spectrometry, HPLC, GC, and monitoring (monitor) system.
	Environmental Chemistry (BSc) 3 credits	Energy balance of the Earth. Physical and chemical background of the greenhouse effect. Climate system. Time trends of greenhouse gases. Climate forcing. Evidences and implications of global climate change. Mitigation policies. § Environmental properties of water. Chemical processes in surface and underground water bodies. Interaction of water with solid, liquid and gaseous substances. Cycling of water. Major pollutants of water. Chemical treatments for drinking water. § The Chapman model and its consequences. Distribution of ozone in the total air column. The ozone layer and its importance. Catalytic (ClOx, NOx, HOx) cycles for ozone depletion. Time trend for stratospheric ozone. Heterogeneous ozone cycles. The ozone hole. Air pollutants, their major sources, global distributions and sinks. Oxidation property of the atmosphere. Formation, importance and reactions of the hydroxi radical. Acid precipitation. Photochemical smog. Preconditions, chemical formation mechanism and important products on various spatial scales. Health and environmental effects. § Atmospheric aerosol, its importance for human health, environment and climate. Main properties of and processes in the aerosol system. Formation mechanisms of aerosol particles. Chemical compositions of particles.

Courses in Environmental Physics	Environmental Physics (BSc) 2 credits	In these courses we overviewed several laboratory practice int he subject of environmental physics. Our measurements mainly covered the area of environmental radiation starting from the acoustic waves, electromagnetic radiation hazard, visible light and going into the area of radioactivity: X-rays, gamma-spectroscopy, annihilation radiation, Cherenkov-radiation, alpha and beta-spectroscopy. These exercises are good examples for those students who intend to work in laboratories using these spectroscopy or other environmental physics methods.
	Environmental Physics Laboratory Practice (BSc) 2 credits	
	Radiation Physics (MSc) 3 credits	
	Environmental Radiation (MSc) 2 credits	
Courses in Environmental Geology	Soil Science (BSc) 2 credits	This course introduces fundamentals of soil science from the mineralogical and organic properties, through physical and chemical processes, until soil forming. The course includes following issues: - Introduction and terminology of soil science; - Minerals in soils: non-silicate minerals (oxides, carbonates, sulphates, phosphates, etc…), primary silicates, pedogenic silicates; - The Soil Organic Matter (SOM); Soil organisms; - Peds and pores; - Soil air; Soil moisture; - Soil physics (water potential, infiltration and distribution, histeresis, soil heat); - Colloids in soils (colloid models, properties); - Soil chemistry (ion exchange, pH, acidity, alkalinity, redox processes); - Soil forming (humification, peat formation, weathering, leaching, lessivage, cheluviation, argillization (siallitization, ferrugination, ferralitization), arenification (podzolization, solod forming), acidification, alkalinization).
	Soil Geography (BSc) 2 credits	This course is based on Soil science course. Soil geography overviews the soil classification and overviews the laws of the distribution of major soil types of the World. The course includes following issues: - Hungarian soil classification; - World reference base of soil resources (2006); - Soils of the Carpathian Basin; - Soils conditioned by climate: soils of the high latitudes, soils of (sub)humid temperate zone, soils of steppic climate, (semi)arid areas; tropical soils; - Soils conditioned by topography; - Soils conditioned by parent material; - Soils conditioned by limited age; - Soils conditioned by Man.

	Mineralogy (lecture) (BSc) 2 credits	Thematic is largely determined by the fact that this topic is practically missing from the Hungarian secondary education. Basic terms need to be introduced first in order to give a solid basis for the later geological subjects as well as to reach the environmental science applications). Basic terms: mineral, rock, ore, gemstone; structural organization of solid matter: short-range order and long-range order (crystal). Chemistry background: the main chemical elements, isotopes, transformation of chemical elements, radioactivity. Crystal chemistry background: chemical bond types, coordination, structure types; polymorphism and isomophism, as demonstrated on carbonate minerals; symmetry and its relation to the properties of crystals; outer symmetry elements; the seven crystal systems; the main physical properties of minerals; crystal growth; polycrystalline materials. Compound types in nature; the basics of mineral systematics; general characteristics of the mineral classes; mineral groups of major environmental relevance (frequent and economically important sulphides and oxides – with parallel environmental and economic aspects discussed; the basics of silicate classification, clay minerals, asbestos minerals, zeolites; apatite as biomineral; aerosol salts); the main rock forming minerals (quartz, silicates, carbonates, etc.).
	Mineralogy (practice) (BSc) 2 credits	The practical session is based on three main units. 1) Getting acquainted with minerals (macroscopic observations, loupe usage and stereomicroscopic observations), the main macroscopic features of minerals - used for mineral identification (shape, cleavage/fracture, transparency, colour). 2) Symmetry, symmetry operations and 3D vision / thinking, demonstrated with the help of crystal models. 3) Mineral groups of major environmental importance: learning of species names, chemical composition, identification upon macroscopic features, economic importance and environmental impact.

	Environmental mineralogy (MSc) 2 credits	The participant environmental processes, resulting in the mineral phases of their awareness of their role in a staging environment. The course syllabus: Environmental mineralogy typical size range of nano range. This range of material examined authorities, special, micro-and higher ranges is different characteristics. Synoptic presentation of the test equipment. The main minerals of natural environments: soil, aerosols, unconsolidated marine and freshwater sediments. Biomineralization : bacterial mineral precipitates. The mineralogical aspects of waste disposal. The built heritage and cultural treasures rockwool conserved. The human body minerals.
Biology	General Microbiology (BSc) 2 credits	Evoltion of prokaryots and the biosphere, tree of life of prokaryots. Cell structure of prokaryotic cells, comparison with eukaryotic cells. Main features of prokaryotic metabolism: forms of acquiring energy and its conservation, fermentation pathways, respiration in prokaryots, light utilization of bacteria Biological cycles of biogenic elements Human microbiology
	Microbiology Practical (BSc) 1 credit	Getting knowledge about working in a microbiological laboratory, acquirement of basic practical knowledge Preparation of microbiological culture media. Demonstration of microbes in the environment. Estimation of microbial abundances. Preparation of pure cultures, observing colony morphology, maintenance of pure cultures Bright-field light microscopy: Simple and complex staining Basic techniques in hygienic microbiology
	Fundamentals of Zoology (BSc) 2 credits	The course aims to acquaint students with the major steps in the development of the animal kingdom, the major groups of morphological, anatomical and taxonomic characteristics. The fauna is organizing the overview of the successive adaptive Taxa stamps awareness. The material is based on the knowledge acquired later animal ecology subject.

	Animal Ecology (BSc) 2 credits	The course aims transfer general knowledge of animal ecology. The presentation plant ecology knowledge that gives complete with a full range of ecological primer. Along the levels of biological organization will look at moving the organization over the individual floors of the laws of the population from the biosphere. The subject provides a theoretical foundation for ecological practices, the nature and environmental courses, respectively environmental science jobs in the future.
	Plant ecology (BSc) 2 credits	Subject to the provision of an ecological approach to global and regional / local knowledge of plant ecology issues of environmental science for students. The theoretical foundation of the nature protection article.
	Field practice (zoology, botany) (BSc) 3 credits	Its purpose is to familiarize the theory of the most important animal and plant groups representatives live on site with the students realize. Also introduced to the habitat of the organism is natural or artificial.
	General ecology (MSc) 4 credits	Global biodiversity patterns; Geosphere-Biosphere Interactions of energy and matter flow in ecosystems, historical biogeography, species richness of communities, the communities in species composition, texture and context, the spatial pattern of the communities, the dynamics of communities, trophic networks and their regulation, Guilds, Limnology (standing waters and flowing waters); Sea ecology, ecosystem function and biodiversity relationship, ecosystem services, Conservation Biology Basics behavioral ecology, global climate change and the expected ecological consequences
	Nature conservation and environmental protection (MSc) 3 credits	The protection of nature and environment protection concept for these two activities. The biodiversity. The biodiversity crisis and the main reasons. Biological basis for the protection of populations. In situ conservation - protected areas. Nature protection in Hungary. The individual responsibility and the possibility of preserving the state of the natural environment.

	Ecology practice (MSc) 4 credits	The exercise at the end of the spring semester in blocks, is field occupations. Students perform self-test tasks in pairs (the measurement execution, evaluation and interpretation of the results is included). Examination forest stand canopy structure light measurement Forest understory species composition and lighting in relationship Vegetation coverage estimates Forest Inventory basic structural characteristics: measurement of tree height and trunk diameter Determine the incidence of exposure of compass plant species Determination Minimal area forest associations Linkage analysis between plant species occurrence Diversity and evenness comparison of two forest stands Comparison of two forests under the vegetation habitat is indicated Field visits to ecological research station Determination of population size Population size estimates mark-recapture method's
	Environmental Microbiology (MSc) 2 credits	Participation of organisms to changing environmental conditions by metabolic processes : transformation of pollutants in energy metabolism , environmental pollutants incorporation of biomass during the build up metabolism . Participation of organisms to changing environmental conditions by metabolic processes and other activities, their impact: a cooxidation (cometabolism). Fundamentals of bioaccumulation metabolism Use of primary and secondary metabolites for environmental biotechnologies , as well as environmental pollutants. The basic techniques for changing environmental conditions : I: Fundamentals of biostimulation and bioaccumulation processes . Local effects and global implications . The basic techniques for changing environmental conditions : II . Bioaugmentation the immobilized enzyme and cell engineering. Release into the

		environment of genetically modified organisms . The immobilized respectively . Basics of suspended biomass using environmental biotechnology processes . Growth curve kinetics of degradation processes . Toxic effects . Biofilms . The composting biotechnology . A pile of composting heat curve and microbial processes in context . Modern composting process. "Green energy" . The wastewater treatment biotechnology. Microbiological effects of physicochemical wastewater treatment. Activated sludge and fixed film biological systems . Biological nitrogen and phosphorus removal. Treatment of sewage . The sludge stabilization aerobic and anaerobic processes . Biogas production and utilization. Placement and utilization of stabilized sludge . " Alternative " wastewater treatment processes . Use of lakes , bed plant cleaners. Tertiary wastewater treatment . Installation and use of treated wastewater . Water , soil , air pollutants and cleaning . The environmental load and the self-cleaning process . Waste -free technologies. Phytoremediation . Technology for the production of drinking water. Industrial and high purity water. Requirements for irrigation waters requirements . The biological effects of "smart " buildings , SBS: The basic methods of environmental analysis . Chemical and biological processes . ecotoxicology . Environmental risk assessment. Bioindication . Case studies in environmental biotechnology . " In situ " " on site " and " ex situ " interventions and combined remediation procedures.
	Ecological modeling (MSc) 2 credits	Population dynamics. Chaos in population dynamics. Continuous-time population dynamics equations. Structured population dynamics. Metapopulations. Predator-prey models. Analysis of Lotka Volterra model phase portrait. A Holling II functional response. If predator-prey dynamics Holling II response. Limit cycles and Hopf bifurcations.

		Competition models. Plankton dynamics. Simple models of the spread of the algae bloom. Population dynamics of open chaotic flow. Phyto-and zoo-plankton in turbulent flow. Food webs modeling. Dynamics of epidemics. When an epidemic breaks out. The epidemic was completed based on the SIR model, phase portrait analysis. SIR model with birth and death. When the infection is controlled in the population abundance?