UNIVERSITY OF DEBRECEN

CENTRE OF ARTS, HUMANITIES AND SCIENCES

FACULTY OF SCIENCE AND TECHNOLOGY

Life Sciences Building

BIOLOGY

BSc Course

2010

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DEBRECEN

With 220 thousand inhabitants Debrecen is the second largest city in Hungary and the centre of the North Great Plain Region. The Eastern gate of Europe - as Debrecen is often referred to is also the seat of Hungarian Protestantism, and as such is often referred to as the "Calvinist Rome". The numerous university faculties, colleges and professional schools have turned Debrecen into the country's most important educational centre. More recently, the city's main focus is the development of its industrial park, and centers for knowledge management in information technology, nanotechnology, pharmacy and biotechnology.

The main square in front of the Great Reformed Church is the real centre of "the city of gatherings". There are fountains, blooming trees, many coffee terraces and it is an intimate scene of outdoor performances. The beautiful Csokonai Theatre and Déri Museum both play an important role in the flourishing cultural life, which characterizes the city. Summer is the time of festivals: a lot of people from other parts of Hungary as well as from abroad visit the famous Debrecen Flower Carnival, the Debrecen Jazz Days, the Béla Bartók International Choir Competition and the International Military Band Festival. The new Conference Centre hosts professional and cultural programs. Week by week, many people support the city's most famous sport clubs, especially the football, handball and basketball teams. Those wishing to take a rest are welcome in the Great Forest, where the famous Debrecen Spa Bath and the Mediterranean Aquaticum are located.

University Calendar

2010/2011 Academic Year

1st Semester study period:	September 13 – December 17, 2010 (14 weeks)
1st Semester exam period:	December 20, 2010 – January 28, 2011 (6 weeks)
2nd Semester study period:	February 7 – May 20, 2011 (15 weeks)
2nd Semester exam period:	May 23 – July 8, 2011
Closing, graduation ceremonies:	June 24 – July 3, 2011

Credit System

The credit system introduced in September 2003 has been made compulsory in each Hungarian university. It serves as a quantitative and qualitative evaluation of student achievement. The credit point is a relative index of cumulative work invested in a compulsory, required or elective subject listed in the curriculum. In addition to active participation at lectures, seminars and practical courses of a given subject (contact classes), the amount of work required for acquiring the knowledge of a subject, involves the student's individual activity (in the libraries and at home) and include the preparation for the exam. Besides the credit point(s) assigned to a subject (quantitative index), students are given grades from 1 to 5 (qualitative index) on passing an exam/course/seminar. The best mark is 5, grade 1 means that you failed. The uniform credit system introduced in Hungary is harmonizing with the European Credit Transfer System (ECTS). The primary goal of ECTS is as follows: 1. the most effective organization of exchange studies at departments of further education abroad, 2. promotion of student mobility, and 3. full recognition of a student's achievement abroad by the mother institution.

The credit based training is flexible. It provides students with a wide range of choice, enables them to make progress by an individual pace and offers a chance to study compulsory and required subjects at different universities in the same country or abroad. Owing to the flexibility nature of the credit accumulation system, „repetition of a year" has lost its meaning. To be mentioned, that students do not enjoy unlimited freedom in the credit system either, as the system does not allow students to randomly pick their subjects in their curriculum or mix modules.

Department of Applied Ecology

Head of department: Dr. Gyula Lakatos Associate professor

E-mail: lakgyu@delfin.unideb.hu

Research fields:

Study and classification of periphyton in shallow waters,
Structure and function of natural and constructed wetlands,
Intensification of biological wastewater treatment,
Application of bioremediation and phytoremediation,
Ecotoxicological studies of heavy metals
Basic development of ESD

Department of Botany

Head of department：Dr. Ilona Mészáros Associate professor

Email: immeszaros@puma.unideb.hu

Research fields

- Molecular taxonomy of plants and phylogeography
- Biology of cyanobacteria Regulation of water blooming and cyanotoxin production
- Plant ecophysiology
- Biologically active secondary metabolites and antiviral compounds from medicinal plants and cyanobacteria.

Department of Ecology

Head of department：Béla Tóthmérész, Professor

Email: tothmerb@delfin.klte.hu

Research fields

- quantitative ecology and its application in zoology, botany and nature protection
- restoration ecology and nature management
- diversity, biodiversity
- long-term ecological monitoring (LTER)
- pattern analysis, and ecological modeling

Department of Evolutionary Zoology and Human Biology

Head of department：Zoltán Barta Professzor

Email: zbarta@dragon.unideb.hu

Animal Anatomy Group

István Nyilas	group leader	Associate professor
Gabriella Kalapos		Assistant professor
Mrs. György Tóth		Technician

Research fields:

- population genetics
- phylogenetics
- conservation biology
- modeling alternative feeding strategies
- biogeography

Department of Genetics and Applied Microbiology

Head of department：Matthias Sipiczki, Professor

Email: lipovy@tigris.unideb.hu

Research fields:

- genetic regulation
- genetic engineering
- applied microbiology
- biotechnology

Department of Hydrobiology

Head of department：Sándor A. Nagy, Associate Professor

Email: snagy@puma.unideb.hu

Research fields:

- water quality
- strategies to maintain biodiversity
- hydroecology

Department of Microbial Biotechnology and Cell Biology

Head of department：István Pócsi, Associate Professor

Email: istvan.pocsi@yahoo.com

Research fields

- development of new antifungal agents
- investigation of fungal siderophores
- characterization of oxidative stress tolerant yeasts
- genotoxicity of heavy metals and irradiation
- mechanism of chromatin condensation

Biology BSc Program

Faculty of Sciences

University of Debrecen, Hungary

Objectives and Perspectives

Our aim is to provide students with basic knowledge in the most important biological fields, to attain skills in fundamental methods of laboratory and applied biology, understand the most important processes of biochemistry, cytology, components of living organisms. The Biology BSc Program covers a broad range of biological science including the most important concepts in modern biology; the levels of biological organization; the fundamental principles of structure and function and the development of ecosystems.

Requirements (total study period, credit points in total, detailed in the Table)

Duration of studies: 6 semesters
Number of ECTS credits: 180

Curriculum for Biology BSc students

Abbreviations: E, oral or written examination; P, practical.

Moduls	Subject/Lecturer	Code	Precondi-tions	Hours/week in semesters						Type of exami-nation	Credit point
				1	2	3	4	5	6		
Modul I.	**Quality Safety** Dr.Jenő Borda	TTBE0001-A		1+0+0						E	1
	Bas. Stat. Inform. Dr. Béla Tóthmérész	TBBE0011-A		1+0+0						E	1
	Bas. Stat. Inform. Dr. Béla Tóthmérész	TBBG0011-A			0+1+0					P	1
	Introd. biol chem. Dr.Zoltán Szurmai	TBBE0301-A		2+0+0						E	3
	Introd. biol chem. Dr.Zoltán Szurmai	TBBL0301-A			0+0+2					P	2
	Fundamentals of biology Dr. Csaba Máté	TBBE0001-A		1+0+0						E	1
	Introduction to chemistry Dr. Róbert Király	TKBE0141-A		2+0+0						E	3
	Introduction to chemistry Dr. Róbert Király	TKBL0141-A		0+0+2						P	1
	Analytics Dr. József Posta	TKBE0541-A			2+0+0					E	3
	Analytics Dr. József Posta	TKBL0541-A				0+0+4				P	3
	Introd. mol. biol. biotechnol. Dr.Gáspár Bánfalvi	TBBE0002-A			1+0+0					E	1
	Basic environmental science Dr. Gyula Lakatos	TEBE0004-A		1+0+0						E	1
	Basic environmental science Dr. Gyula Lakatos	TEBG0004-A		0+1+0						P	1
	Introduction to ecology Dr. Béla Tóthmérész	TBBE0003-A			1+0+0					E	1
				8+1+2	**4+1+2**	**0+0+4**					**23**
Modul II.	**Plant organology and anatomy** Dr. Mária Papp	TBBE0101-A		3+0+0						E	4
	Plant organology and anatomy Dr. Mária Papp	TBBL0101-A			0+0+2					P	2
	Plant taxonomy Dr. Gábor Matus	TBBE0102-A			3+0+0					E	4
	Plant taxonomy Dr. Gábor Matus	TBBL0102-A				0+2+0				P	2
	Animal taxonomy Dr. István Rácz	TBBE0202-A			3+0+0					E	4
	Animal taxonomy Dr. István Rácz	TBBG0202-A				0+4+0				P	3
	Fundam. biochem. Dr. János Kerékgyártó	TBBE0302-A			2+0+0					E	3
	Fundam. biochem. Dr. János Kerékgyártó	TBBL0302-A				0+0+2				P	2
	Cell biology I. Dr. Gáspár Bánfalvi	TBBE0502-A				3+0+0				E	4
	Field practicals Dr. Attila V. Molnár	TBBG0150-A					*			P	1
				3+0+0	**8+0+2**	**3+6+2**					**29**

Moduls	Subject/Lecturer	Code	Precondi-tions	Hours/week in semesters						Type of exami-nation	Credit point
				1	2	3	4	5	6		
Modul III.	**Animal physiology I.** Dr. Gáspár Bánfalvi	TBBE0205-A					2+0+0			E	3
	Animal physiology I. Dr. Gáspár Bánfalvi	TBBL0205-A					0+0+2			P	2
	Plant physiology I. Dr. György Borbély	TBBE0105-A				3+0+0				E	4
	Plant physiology I. Dr. György Borbély	TBBL0105-A				0+0+2				P	2
	Human biology Dr. László Szathmáry	TBBE0210-A						2+0+0		E	3
	Genetics I. Dr. Mátyás Sipiczki	TBBE0401-A					3+0+0			E	4
	Genetics I. Dr. Mátyás Sipiczki	TBBG0401-A						0+0+2		P	2
	General Microbiology Dr. István Pócsi	TBBE0505-A			2+0+0					E	3
	General Microbiology Dr. István Pócsi	TBBL0505-A				0+0+2				P	2
	Molecular biology I. Dr. Mátyás Sipiczki	TBBE0515-A					2+0+0			E	3
	Biotechnology I. Dr. István Pócsi	TBBE0510-A				2+0+0				E	3
	Basic ecology I. Dr. Béla Tóthmérész	TBBE0602-A			2+0+0					E	3
	Basic ecology II. Dr. Béla Tóthmérész	TBBE0603-A				1+0+0				E	1
	Basic ecology II. Dr. Béla Tóthmérész	TBBL0603-A				0+0+1				P	1
	Biogeography Dr. Attila V. Molnár	TBBE0110-A				2+0+0				E	3
	Evol. biol. popul. genet. Dr. Katalin Pecsenye	TBBE0215-A						2+0+0		E	3
	Evol. biol. popul. genet. Dr. Katalin Pecsenye	TBBG0215-A						0+0+2		P	1
	Environmental protection Dr. Gyula Lakatos	TBBE0610-A						2+0+0		E	3
	Environmental protection Dr. Gyula Lakatos	TBBG0610-A						0+1+0		P	1
	Nature protection Dr. Albert Tóth	TBBE0615-A				2+0+0				E	3
	Etology Dr. Zoltán Barta	TBBE0220-A				2+0+0				E	3
	Micology Dr. István Pócsi	TBBE0508-A			1+0+0					E	1
	Micology Dr. István Pócsi	TBBL0508-A				0+0+1				P	1
					5+0+0	**12+0+6**	**7+0+2**	**6+1+4**			**55**

Moduls	Subject/Lecturer	Code	Precondi-tions	Hours/week in semesters						Type of exami-nation	Credit point
				1	2	3	4	5	6		
Modul IV.	**Plant physiology II.** Dr. György Borbély	TBBE0106-A					2+0+0			E	3
	Plant physiology II. Dr. György Borbély	TBBL0106-A					0+0+2			P	2
	Animal physiology II. Dr. Gáspár Bánfalvi	TBBE0206-A						1+0+0		E	1
	Animal physiology II. Dr. Gáspár Bánfalvi	TBBL0206-A						0+0+2		P	2
	Cell biology II. Dr. Gáspár Bánfalvi	TBBE0503-A					1+0+0			E	1
	Cell biology II. Dr. Gáspár Bánfalvi	TBBL0503-A					0+0+2			P	2
	Biotechnology II. Dr. István Pócsi	TBBE0511-A					1+0+0			E	1
	Biotechnology II. Dr. István Pócsi	TBBL0511-A					0+0+2			P	2
	Microbiology Dr. István Pócsi	TBBE0506-A					1+0+0			E	1
	Microbiology Dr. István Pócsi	TBBL0506-A						0+0+2		P	2
	Hyrobiology Dr. Sándor A. Nagy	TBBE0635-A			2+0+0					E	3
	Hyrobiology Dr. Sándor A. Nagy	TBBG0635-A				0+0+1				P	1
	Genetics II. Dr. Mátyás Sipiczki	TBBE0402-A						1+0+0		E	1
	Genetics II. Dr. Mátyás Sipiczki	TBBL0402-A							0+0+2	P	2
	Molecular biology II. Dr. Mátyás Sipiczki	TBBE0516-A					1+0+0			E	1
	Molecular biology II. Dr. Mátyás Sipiczki	TBBL0516-A					0+0+2			P	2
	Bioinformatics Dr. Mátyás Sipiczki	TBBE0410-A				1+0+0				E	1
	Bioinformatics Dr. Mátyás Sipiczki	TBBG0410-A					0+2+0			P	2
					2+0+0	**1+0+0**	**6+2+8**	**2+0+2**	**0+0+2**		**30**

Moduls	Subject/Lecturer	Code	Precondi-tions	Hours/week in semesters						Type of exami-nation	Credit point
				1	2	3	4	5	6		
Modul V.	**Block I. Viticulture**										
	Microbiol vine making Dr. Zsolt Szilágyi	TBBE0420-A						3+0+0		E	4
	Vine biotechnology Dr. Mátyás Sipiczki	TBBE0425-A							2+0+0	E	3
	Vine biotechnology Dr. Mátyás Sipiczki	TBBL0425-A							0+0+2	P	2
	Block II. Food industry										
	Basics of food quality management Dr. Zoltán Győri	TBBE0520-A							1+0+0	E	1
	Food microbiol. biotechnol. I. Dr. Tünde Pusztahelyi	TBBE0521-A						2+0+0		E	3
	Food microbiol. biotechnol. I. Dr. Tünde Pusztahelyi	TBBL0521-A						0+0+3		P	2
	Food microbiol. biotechnol. II. Dr. Tünde Pusztahelyi	TBBE0522-A							2+0+0	E	3
	Block III. Fermentation										
	Factory visits Dr. Levente Karaffa	TBBG0550-A						*		P	1
	Process. unit oper. bioengin. I. Dr. Levente Karaffa	TTBE5001-A					2+0+0			E	3
	Process. unit oper. bioengin. II. Dr. Levente Karaffa	TTBE5002-A						2+0+0		E	3
	Process. unit oper. bioengin. II. Dr. Levente Karaffa	TTBL5002-A						0+0+3		P	2
	Microbial physiology Dr. Attila Szentirmai	TBBE0525-A					2+0+0			E	3
	Microbial physiology Dr. Attila Szentirmai	TBBL0525-A					0+0+2			P	1
	Block IV. Utilization of waste products										
	Environmental Technology Dr. György Deák	TKBE1114_EN					2+2+0			E	4
	Environmental Technology Dr. György Deák	TKBL1114_EN					0+0+2			P	2
	Environ. protect. biotechnol Beáta Tóthné Kosztin	TBBE0611-A					1+0+0			E	2
	Environ. protect. biotechnol Beáta Tóthné Kosztin	TBBG0611-A					0+2+0			P	1
	Toxicology and ecotoxicology Dr. Gyula Lakatos	TBBE0645-A					1+0+0			E	2
	Toxicology and ecotoxicology Dr. Gyula Lakatos	TBBL0645-A					0+2+0			P	1
	Block V. Plant biology										
	Plant biochem. mol. biol. Dr. György Borbély	TBBE0120-A					3+0+0			E	4
	Plant biochem. mol. biol. Dr. György Borbély	TBBL0120-A					0+0+2			P	2
	Plant biotechnology Dr. Gyula Surányi	TBBE0125-A					2+0+0			E	3
	Block VI. Biology of medical plants										
	Medical plant products Dr. Gábor Vasas	TBBE0131-A							2+0+0	E	3

	Medical plant products Dr. Gábor Vasas	TBBL0131-A							0+0+1	P	1
	Histology of medical plants Dr. Márta Hamvas	TBBE0130-A						1+0+0		E	1
	Histology of medical plants Dr. Márta Hamvas	TBBL0130-A						0+0+2		P	1
	Toxic and medical plants Dr. Gábor Vasas	TBBE0132-A						2+0+0		E	3
	Block VII. Cell and tissue cultures										
	Cell cultures and cell preparations tech. Dr. Gábor Nagy	TBBE0230-A							2+0+0	E	3
	Cell cultures and cell preparations tech. Dr. Gábor Nagy	TBBL0230-A							0+0+2	P	2
	Techniques of image formation Dr. Gábor Nagy	TBBE0530-A						2+2+0			5
	Students can freely choose 20 credit subjects from each block of modul V.										**20**
Modul VI.	**Thesis**	TBBG1001-A						*			**14**
	Free optional subjects										**9**
Number of ECTS credits:											**180**

Subject programs

Modul I. Subjects of basic training

QUALITY MANAGEMENT

Lectures:1h/week
Credit:1
Examination: written
Lecturers: János Török staff scientist

Aim of the course: The aim of the lecture is to provide students basic knowledge on the quality management and the ISO standards.
Short description of course: History of quality management. Development of the ISO standard system, advantages. The essence of the TQM and EFQM. The ISO 9000:2000 standard system; the idea of quality and quality management, customer in the focus, respect for law, process management and control, the PDCA ring, sustained development, the ISO 9004:2000. Presentating the ISO 9000:2000 standard; the system (handbook, documents), responsibility of the management (quality policy, quality aims, sources of power, communication, revision), production and supply in the ISO, customer service, measurement and control, correction and prevention.
Literature:

1. ISO 9001:2000 Standard
2. ISO 9004:2000 Standard
3. Quality Management (5th Edition) by David L. Goetsch, Stanley B. Davis. Prentice Hall; 5 edition (June 1, 2005)
4. Quality Management: Introduction to Total Quality Management for Production, Processing, and Services (4th Edition) by David L. Goetsch, Stanley B. Davis Prentice Hall; 4 edition (April 17, 2002).

BASICS OF STATISTICS AND INFORMATICS

Lectures: 1+1
Credit: 2
Examination: written
Lecturer: Béla Tóthmérész, professor

Aim of the course: Basics of informatics is introduced briefly from practical point of view. During the course the principles of data analyses is introduced using the R program language and programming environment for statistical computing.
Short description of course: Overview of the history of computer science; discussion of the main operating systems (Unix, Linux, DOS, Windows). Programming language concepts. Elementary data analysis, styles of data analysis. Descriptive statistics. Introduction to R and R programming environment. R graphics. Elementary probability theory. Random variables, discrete and continuous.Probability distributions. Discrete and continous distributions. Statistical models. Estimation. Hypothesis testing. Statistical decision making. The main parametric and nonparametric statistical tests.
Linear regression.

Literature
Dalgaard, P. 2002: Introductory statistics with R. Springer, Berlin and New York.
Maindonald, J.H.H. and Braun, J. 2003: Data Analysis and Graphics Using R: An Example-Based Approach. Cambridge Series in Statistical and Probabilistic Mathematics. Cambridge University Press, Cambridge.

TKBE0141 INTRODUCTION TO CHEMISTRY
Lectures:2h/week
*Credits:*3
Examination: written
Lecturer: Róbert Király associate professor

The aim of the course is to give a basic knowledge in general and inorganic chemistry for advanced studies. The practicals give a possibility to learn the most important fundamental laboratory operations, measurements and calculations.
The program of the lectures covers the following topics: Material systems. The states of matter and phase changes. Spontaneous processes. The basis of thermochemistry. General characterization of equilibria. Homogeneous equilibria: Acids and bases, the fundamentals of pH-calculations, redox-equilibria, the formation and characteristics of complexes. Heterogeneous equilibria: The process of dissolution and the properties of solutions, distribution equilibria between two solvents, adsorption of gases and liquids. The basis of kinetics. Basic nuclear chemistry. The structure of atoms: The quantum description and the quantum numbers. The electron structure of atoms and the periodic table of elements. Periodic properties: Ionization energy, electronaffinity and electronegativity, the size of atoms and ions. The types of chemical bonds and their characterization. The occurence and abundance of elements. The most important elements and their compounds of high practical importance.
Literature:
McMurry, J., Fay R.C.: Chemistry, Fourth Edition. Pearson Education International, Inc., Prentice Hall, New Jersey, 2004.ISBN 0-13-121631-7

TKBL0141 INTRODUCTION TO CHEMISTRY PRACTICALS
*Practicals:*2
*Credits:*1
Examination: written tests during the semester
Lecturer: Róbert Király associate professor

Program of practicals: The practical part of the course is announced as a block lasting for five weeks and taking about half of the semester. Of the five practicals four, with the exception of the first one, will be preceded by a 2 h seminar. *In the laboratory*, students learn basic laboratory work, including preparation of solutions, calibration of volumetric vessels, recrystallization, titration, extraction and operation with gas-cylinders. Weighing, volumetric measurements and determination of density are also performed. *In seminars* students will become familiar with fundamental laboratory calculations. The calculation of concentration, titration results, the pH of strong acids and bases will be taught.
Literature:
General Chemistry Laboratory. Lab Manual Supplementary material compiled in the Department of Inorganic and Analytical Chemistry. University of Debrecen, 2004.

Villányi A.: How to Get an A in Chemistry (in English) Műszaki Könyvkiadó, Budapest, 2002.

TKBE0541 ANALYTICAL CHEMISTRY
Lectures: 2
Credit: 3
Examination: written
Lecturer: József Posta professor

The aim of the course is to make known the principles of classical and modern instrumental methods of analysis and apply them in the qualitative and quantitative determination of components from systems and samples used in the biological, human biological research.
Short description of the lectures: The role of the analytical chemistry in biology. The relationships and differences between instrumental and classical methods of analysis. Characterization of efficiency of analytical methods. Characteristics of absolute and relative analytical methods. Analytical data processing, the method error. Classical gravimetric and volumetric methods and their application in water analysis. Classification of physical and chemical methods of analysis. Principles of electrochemical, optical, magnetical, thermal, radiochemical and chromatographic methods. Principles of measurements and practical questions related to potentiometry, polarography, optical emission spectroscopy, spectrography, flame photometry, atomic absorption spectrometry, ultraviolet/visible spectrophotometry, mass spectrometry and derivatography. Evaluation of analytical data. Composition and sample simulation of calibration solutions. The method of comparison and the method of additions. Principles of statistical data processing. Main component, cluster, discriminancy analysis. Certified reference materials and their role in the analysis of human biological samples. Quality control and quality assurance.
Literature:
Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A.: Instrumental Methods of Analysis
Wadsworth, Belmont, California,1981
Pecsok, R.L., Shields, L.D.: Modern Methods of Chemical Analysis
Wiley & Sons, Inc., New York, 1968
Scoog, D.A., Holler, J.F., West, D.M.: Analytical Chemistry
Saunders College Publishing,1999

TKBL0541 ANALYTICAL CHEMISTRY PRACTICALS
Practicals: 4
Credit: 3
Examination: Written and oral tests during the semester
Lecturer: József Posta professor

Short description of practicals: Sampling and sample preparation. Qualitative analysis of an unknown solution. Cations, anions, alkalinity and carbonate hardness, complexometric determination of calcium and magnesium of an aqueous solution. Oxidoreductive titrations: permanganometry, determination of oxygen content by Winkler in water samples. Flame photometry (FES): determination of sodium ion content of tap water using the method of additions. Atomic absorption spectrometry (AAS): determination of iron (III), manganese (II), magnesium (II) or cadmium (II) using the comparison method for calibration. Spectrophotometry (MAS): side-by-side determination of chromium (III) and chromium (VI) ions, determining the concentration of a methyl red indicator solution. pH-metry: determination of the exact concentration of an about 0,1 mol/dm^3 hydrochloric acid solution.

Potentiometry: determination of the fluoride content of a Dentocar pill by direct potentiometry and by the method of additions. Chromatography: separation of amino acids, green plant (grass) dyes, red pepper dyes. Sewage water analysis using complex analytical methods.

Literature

Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A.: Instrumental Methods of Analysis
Wadsworth, Belmont, California,1981
Pecsok, R.L., Shields, L.D.: Modern Methods of Chemical Analysis
Wiley & Sons, Inc., New York, 1968
Scoog, D.A., Holler, J.F., West, D.M.: Analytical Chemistry
Saunders College Publishing,1999

TBBE0001 FUNDAMENTALS OF BIOLOGY

Lectures: 1
Credit point: 1
Examination: written
Lecturer: Csaba Máthé senior lecturer

Aims. The subject intends to present to students the brief history of biological science and the most important concepts in modern biology; the levels of biological organization; the fundamental principles of structure and function in biological systems; the development of current biological ideas.

Subject areas: The distinctive features of living matter. History of biological ideas. The scientific methodology of life sciences: examples of morphological, cytological, biochemical, ecological etc. investigations.

The chemical basis of life. Viruses: their evolutionary origin and structural features. Cellular theory placed in historical context. The prokaryotic and eukaryotic cell, the endosymbiotic theory of the origin of eukaryotic cells. Comparison of animal and plant cells. The fundamental principles of how a cell functions: cooperation of structures/cell compartments, basic principles of biochemical processes. Autotrophy and heterotrophy. Cell division: mitosis and meiosis.

From unicellular to multicellular organisms. Cells, tissues, organs. The regulation of biological processes in plants and animals: principles of functions of hormonal and nervous systems. Basic processes of nutrition, respiration, reproduction.

Basic kingdoms in the living world: monera, protists, fungi, plants and animals. Definition of species, and brief history of systematics. Populations: their definition, interactions, and roles in biological evolution. Short history of evolutionary theory, from the beginnings to recent concepts.

Short history of genetics. The mendelian inheritance, cytogenetics, basic principles of the structure and function of nucleic acids; DNA, as the fundamental genetic material.

Short presentation of ecology, as the science of interactions between organisms and populations.

Summary: presenting the principles of life, with emphasis on living matter as an open thermodynamic system, on self-regulation and evolution.

Literature:

Postlethwait, J.H., Hopson, J.L., eds. (1989): The nature of life. McGraw-Hill Publ. Co.
Starr, C., Taggart, R., eds. (1989): Biology- the unity and diversity of life. Wadsworth Publ. Co.

TBBE0002 INTRODUCTION TO MOLECULAR BIOLOGY AND BIOTECHNOLOGY
Lectures: 1
Credit point: 1
Examination: written
Lecturer: Gaspar Banfalvi professor

Aim of the course*:* To enrich molecular knowledge through the study of *in vitro* and *in vivo* processes of transfer of genetic information, by incorporating them into the already existing knowledge and to contribute to the development of a molecular view.
The course involves*:* Major unifying conceptions of biology: cell theory, evolution, transfer of information. Basics of transfer of cellular (*in vitro)* information. Molecular models to visualize the structure of informational macromolecules. Computer analysis of macromolecules. Biological evolution. Genomes. Signal transduction. Arteficial transfer of information. Nucleic acid sequencing. DNA chip technology. Human genome program. Human gene therapy. Planning drugs. Introduction to plant molecular biology.
Literature:
Maulik, S. and Patel, S.D.: Molecular biotechnology Wiley-Liss, New York, 1997.
Darnell, J.E., Lodis, I. and Baltimore, D. Molecular Cell Biology. Scientific American Books Inc., New York, 1986.

TBBE0004 BASIC ENVIRONMENTAL SCIENCE

Lectures: 2
Credit: 2
Examination: written
Lecturer: Gyula Lakatos associate professor

Aims of the course: The student should acquire the more important natural science and social science connections of the based on ecology and focused on living organisms. The student have knowledge based on ecology and environmental elements of the environmental sciences. The student should be able to understand the necessity to recognise the sustainable development, knowing the history of environment protection and nature conservation.

Lectures: Environmental sciences and the ecological principles. Terminological system of our environment. Environmental sciences and interdisciplinary. Challenge for science. The principle of precaution. Environmental problems. Natural environment. The surface of the Earth. Soil, the hydrosphere, the atmosphere.
The history of the natural conservation and the environmental protection; the sustainable development. Sustainable development. The economics of the human populations and the environmental sources. Limits of the growth. Human demography. The future of human populations. Resources and reserves. The soil as natural resource and the sustainable agriculture. The water supply and the water as power source. Biological resources. The effect of the human activity on the natural environment. The pollution of the atmosphere. Water pollution. The environmental pollution of industry. Technological forecast and the environment. Sustainable development: as a challenge
References:
Jackson, A,R.W., Jackson, J.M. 1996: *Environmental Science. The natural environment and human impact.* Longman, Singapore.

Brundtland, G.H. (Chair) 1987: *Our common future.* Oxford: Oxford University Press.
Cunningham, W.P. & Saigo, B.W. 1995: *Environmental Science. A global concern.* Dubuque: Wm.C. Brown Publishers.

TBBE0003 INTRODUCTION TO ECOLOGY
Lectures: 1
Credit: 1
Examination: written
Lecturer: László J. Szabó senior lecturer

Short descriptrion of the course. Concept of the geographical sphere and its features. Dialectics of biological organization levels. Concept of synbiology. Concept of ecology. Fundamental concepts: ecological factors, populations, groups of populations, communities. Fundamentals of plant ecology; effects of environmental factors on plants. Types of plant life forms. Plant-plant interactions. Fundamentals of animal ecology; plant-animal and animal-animal interactions. Fundamentals of aquatic ecology; features of water bodies. Features of aquatic and semi-aquatic (wetland) biotopes. Fundamentals of terrestrial ecology. Features of the air and soils. Features of terrestrial biotopes. Fundamentals of quantitative ecology; biodiversity: its role and importance. Fundamentals of practical ecology. Effects of people on their environment: global and local impacts. Environment and nature conservation.
Literature:
Begon M. – Harper, J.L.- Townsend, C.R.1990.: Ecology. *Blackwel, Oxford.*

MODUL II. SUBJECTS OF BASIC TRAINING

TBBE0101 PLANT MORPHOLOGY AND ANATOMY
Lectures: 3
Credits: 3
Examination: written
Lecturer: Maria Papp associate professor

Aim of the course is to give basic information on plant cells, tissues and plant forms.
Lectures: The course involves chapters from plant cell biology, discussing the characteristic plant cell compartments such as plastids, cell wall and vacuoles. It presents the cell types of different plant tissues.It involves the anatomy of primary organs and the study of the secondary tissues in roots and trunks (emphasizing the importance of secondary xylem and phloem) as well. Morphology elicits the amazing diversity of structures and forms of plants. Beside the above topics, the course is guiding students through the life cycles and the different reproduction forms in the kingdom of plants. Emphasis is placed on evolutionary trends and on the fact that all plant structures are the result of the natural selection.
Literature
Mauseth, J., D. 1995: Botany, An introduction to plant biology, Saunders College Publishing, Philadelphia Fort Worth Chicago San Francisco Montreal Toronto London Sydney Tokyo.
Bell A.D. 1991: Plant form. An illustrated Guide to Flowering Plant Morphology. Oxford University Press, Oxford, New York, Tokyo

TBBL0101 PRACTICALS OF PLANT MORPHOLOGY AND ANATOMY

Lectures: 2
Credit: 1
Examination: written
Lecturer: Mária Papp associate professor

Aim: During the practicals the students study plant cell structures, tissues, and their appearance and arrangement in the different organs by light microscopy. Different forms of plant organs are studied by taking typical plants representing different evolutionary complexity. All these experimental approaches serve the better understanding of the topics of the lectures.

Literature

Mauseth, J., D. 1995: Botany, An introduction to plant biology, Saunders College Publishing, Philadelphia Fort Worth Chicago San Francisco Montreal Toronto London Sydney Tokyo
Bell A.D. 1991: Plant form. An illustrated Guide to Flowering Plant Morphology. Oxford University Press, Oxford, New York, Tokyo

TBBE0102 PLANT TAXONOMY

Lectures: 3
Credit: 4
Examination: written
Lecturer: Gábor Matus senior lecturer and George Borbely professor

Aims: The subject intents to provide a concise summary of present knowledge of plant taxonomy.

Subject areas: Plant Taxonomy is an introductory course in plant taxonomy with covers all major groups including Cyanobacteria, algae, Bryo- and Pterydophytes, Gymno- and Angiosperms in an evolutionary context. Objectives are recognition of a number of important plant families, genera and species; development and geography of the taxa concerned; introduction to the relevant literature on plant taxonomy. The subject matter is to be presented in a series of lectures featuring a selection of certain important taxa. Demonstrations on the practicals offer the students the possibility to acquaint themselves in a practical way with the subject matter of the lecture course. This should enable them to recognize directly the important families, study plant characters and learn the basics of plant identification.

Literature:

Mauseth, J.D. 1995. Botany. An introduction to plant biology. Saunders College Publishing, Philadelphia - Fort Worth – Chicago – San Francisco – Montreal – Toronto – London – Sydney – Tokyo
van den Hoek, C., Mann, D.G., Jahns, H.M. 1995. Algae. An Introduction to phycology. Cambridge University Press
Scagel, R.F., Bandoni, R.J., Maze, J.R., Rouse, G.E., Schifield, W.B., Stein, J.R. 1984. Plants, an evolitionary survey. Wadsworth Publishing Company.

TBBG01150 PLANT SYSTEMATICS AND FLORISTICS, PRACTICALS

Practicals: 2
Credits: 1
Examination: oral and written
Lecturer: Gábor Matus senior lecturer and Attila V. Molnár senior lecturer

Aim: The subject intents to improve practical knowledge in plant systematics.

Subject areas: The course includes basic information on plant biotopes influenced by physical factors of geology, physical geography and climate of the Carpathian Basin with special respect to Hungary. The history of floristical diversity and its sources. The stress is on practical exercises in determination and identification of those groups of Cryptogams (Cyanobacteria, Algae, Fungi, Mosses and Liverworts) and of vascular plants which are frequent, typical or of indication value to various biotopes of Central Europe with special emphasis on the Carpathian Basin and Hungary.
Students are taught in groups of maximum 10 people. Demonstration uses color slides as well herbaria specimens while at the end of the course (spring) exercises on determination are also included (Algae, Ranunculaceae, Cyperaceae).

Literature:

Jávorka, S. & Csapody, V. 1929, 1999: Iconographia florae partis austro-orientalis Europae Centralis. Akadémiai Kiadó, Budapest.
Soó, R. 1980: Systematical and geobotanical handbook of Hungarian Flora and Vegetation, Volume 6., Akadémiai Kiadó, Budapest.

TBBG01150 FIELD PRACTICALS

Lectures: 1
Credit: 1
Examination: oral and/or written
Lecturer: Attila Molnár V. senior lecturer
Precondition: TBBE0102

Aims: The aim of the course is to give a practical insight into the flora and vegetation of the Pannonian Biogeographycal Region. Diverse habitats, their characteristic vascular species and plant associations will be studied. Field observations give an opportunity for getting acquainted with several important representatives of the flora as well as for understanding principals of habitat classification followed in the European Community (EUNIS protocol).

Short description of the course: The study sites involve typical lowland and mountainous areas of the East-Hungarian region. At the Hortobágy National Park typical salty and loess grassland communities, adapted to traditional forms of animal husbandry, will be studied. Abiotic and biotic factors influencing their spatial pattern and succession or others leading to their degradation into weedy communities will be discussed.
At the Tokaj-Bodrogzug Protected Landscape area a great variety of habitats subject to variation in base rock, exposure, water supply and land use will be demonstrated. A rich flora including endemics and several legally protected species will be studied. Plant communities will be discussed from water macrophytes to seasonally inundated floodplain meadows and forests through loess wall vegetation, loess steppes, bushes and continental loess-steppe forests on foothills as well as xerothermic andesite steppe meadows and various oakwood and oak-hornbeam forest communities on higher elevations. Practical problems of conservation especially invasion of alien species and their control in various habitats will be discussed.

Literature

Borhidi, A. 1996. An annotated checklist of Hungarian plant communities I. The non-forest vegetation. In: Borhidi, A. (ed.) Critical Revision of the Hungarian Plant Communities. Janus Pannonius University, Pécs. 43-94.
Borhidi, A., Kevey, B. 1996. An annotated checklist of Hungarian plant communities II. The forest vegetation. In: Borhidi, A. (ed.) Critical Revision of the Hungarian Plant Communities. Janus Pannonius University, Pécs. 95-138.

Molnár, Zs. & Borhidi, A. 2003. Hungarian alkali vegetation: origins, landscape history, syntaxonomy, conservation. *Phytocoenologia* 33: 377-408.
Polunin, O. 1976. Trees and bushes of Europe. Oxford University Press.
Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, I.B.K. (eds.) 1976-1980. *Flora Europaea* Vols. 1-5. Cambridge University Press, Cambridge.
http://eunis.eea.eu.int

TBBE0202 ANIMAL TAXONOMY

Lectures: 3
Credit points:4
Examination: written
Lecturer: István A. Rácz associate professor

Aims: During the course the students will study the principles and methods of taxonomy and systematics and they will gain knowledge on the practical application of these fields. During the lectures the main goal is to highlight phylogenetic relationships between major taxonomic groups of animals.
A short description of the course: The principles, basic methods and history of animal taxonomy and systematics. Phylogenetic systematics, categories of taxonomy, and the zoological nomenclature. The taxonomy of single cell organisms. The origin of multicellular animals, and the main levels and directions of their phylogeny. The phylogenetical taxonomy of the main phyla of the animal kingdom. Species important from theoretical and practical point of view.
Literature:
Barnes, R.S.K., Calow, P. and Olive, P.J.W.: The Invertebrates: a new synthesis. Balckwell Sci Publ, 1988, Oxford
Nielsen, C.: Animal Evolution. Interrelationships of the Living Phyla. Oxford Univ Press, 1996.

TBBG 0202 ANIMAL TAXONOMY PRACTICALS

Practicals: 4
Credits: 2
Examination: written
Lecturer: István A. Rácz associate professor

Short description: An introduction to the methodology of collecting, preparing and identifying animals. Practicals deal with those species which are important from theoretical and practical point of views.
On the practicals the students will be introduced to the methodology of taxonomy and gain a practical knowledge of common species.
Literature:
HJ Müller, H.J.: Bestimmung wirbelloser Tiere im Gelände. VEB Gustav Fischer Verl. Jena, 1985

TBBE301CHEMICAL BASIS OF BIOLOGY
*Lectures***:** 2
Credit: 3

Examination: written and oral
Lecturer: Zoltán Szurmai senior staff scientist

Aim of the course is to give students a basic knowledge in organic and bioorganic chemistry.
The course involves topics of organic and bioorganic chemistry. Physical and chemical properties of hydrocarbons, aromatic compounds, alcohols, ethers, aldehydes, ketones, carboxylic acids and their derivatives. Organic compounds containing heteroatoms. Isomerisms among organic compounds. Biomolecules: amino acids, peptides, proteins, carbohydrates, nucleic acids, lipids. Biological membranes.

Literature:
Ternay, A.L. Jr. Contemporary Organic Chemistry, W. B. Saunders Co., 1979.
Stryer, L. Biochemistry, W. H. Freeman and Co., 2004.

TBBL0301 PRACTICALS ON CHEMICAL BASIS OF BIOLOGY

Practicals: 2
Credit:1
Examination: written and oral
Lecturers: Zoltán Szurmai senior staff scientist, János Kerékgyártó senior staff scientist

The practicals involve: amino acids, proteins: test reactions, ion exchange chromatography. Salting-out of proteins. Purification of proteins: dialysis, gel-filtration chromatography. Quantitative determination of proteins by means of photometry. Carbohydrates: test reactions, thin-layer chromatography (TLC). Quantitative determination of the reducing sugar content of plant samples. Lipids: Saponification of plant oil. Detection and TLC for cholesterol. Investigation of bile. Hydrolysis of triacylglycerols by lipases. Nucleic acids: Experiments with RNA. Hydrolysis of yeast RNA. Detection of chemical components of RNA. Quantitative determination of phosphorus content by means of photometry.
Literature: handouts

TBBE0302 FUNDAMENTALS OF BIOCHEMISTRY

Lectures: 2
Credit: 3
Examination: oral
Lecturer: János Kerékgyártó senior staff scientist

Short description: Protein structure and function; Oxygen-transporting proteins; Enzymes and mechanisms of enzyme action; Structure and function of biological membranes; Carbohydrate metabolism: glycolysis, glyconeogenesis, glycogen synthesis, glycogenolysis, pentose phosphate pathway. The citric acid cycle; Electron transport and oxidative phosphorylation; Fatty acid metabolism; Amino acid metabolism; Photosynthesis; Hormone action and metabolic control mechanisms; Structure of nucleic acids; The genetic code and flow of genetic information; DNA replication and repair; RNA synthesis: the translation machinery and mechanism of translation; Immunobiochemistry.

Literature:
L. Stryer, Biochemistry, W. H. Freeman and Co., 2005.

TBBL0302 BIOCHEMISTRY PRACTICALS

Practicals: 2
Credit: 1
Examination: written
Lecturer: János Kerékgyártó senior staff scientist

Short description of practicals: The practicals comprise experiments in the following areas: purification of enzymes and determination of kinetic parameters; separation and purification methods of biomolecules.

Literature:

Switzer, R. and Garrity L.: Experimental biochemistry. Theory and exercises in fundamental methods, Third edition **;**W.H. Freeman and Company New park; (1999**)**ISBN: 0-7167-3300-5 (EAN: 9780716733003)

TBBE0502 CELL BIOLOGY I

Lectures: 3
Credits: 3
Examination: oral
Lecturer: Gaspar Banfalvi professor

Aim of the course*:* The course provides insight not only into the morphology of the eukaryotic cell, including the constituents of the animal cell but also into their function and discusses them at molecular level.

The course involves*:* Bioelements, biocompounds, reactions taking place in cells. The basic principles of cellular metabolism. Characterization of prokaryotic and eukaryotic cells. Basic methods of cellular research. The origin of the eukaryotic cell. The structure and function of nucleus, mitochondrion, peroxisomes, endoplasmic reticulum, Golgi apparatus, lysosomes, ribosomes. Building blocks of the cytoskeleton. Cell membrane. Markers and receptors of the cell surface. The structural organization of nucleic acids and proteins. Chromosomes, plasmids, viruses, bacteriophages. Principles of bioenergetics, the ATP cycle. Basics of thermodynamics. Subcellular localization of proteins. Enzymes. Formulas of basic biomolecules.

Literature*:*

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., and Walter, P.: Molecular Biology of the Cell. 4th Edn. Garland Publishing, Inc. New York.
Thorpe, N.: Cell Biology, John Willey and Sons, Inc. New York. 1984.

MODUL III. SUBJECTS OF BASIC PROFESSIONAL TRAINING

TBBE0105 PLANT PHYSIOLOGY I.

Lectures:3
Credits: 4
Examination: written
Lecturer: György Borbély professor

Aims: Undergraduates majoring in biology have the opportunity to gain extensive knowledge of the scientific basis of plant physiological investigations ranging from plant macromolecules, through genes and cells, to organisms and their interactions with the environment. Department of Botany will make scholarly scientific and practical advances that will address the changing needs of society.

Lectures: Physiology of plant cells. Integrated functioning of physiological processes in photosynthesizing pro- and eukaryotes. Assimilation and transport: photosynthesis, water, and ion absorption, translocation. The global importance of photosynthetic electron transport. C2, C3, C4 CAM types of photosynthetic carbon fixation. Permeability of plant membranes and membrane potential. Water uptake, transport and functioning of stomata. Nutrient uptake from the soil (nitrogen, sulfur, phosphorous etc.). Nitrogen fixation of cyanobacteria (DNA

rearrangement) and *Rhizobium* species. Nitrate and nitrit reduction. Amino acid and protein synthesis. Characteristics of plant respiration (glycolisis, citrate cycle and terminal electron transport). Growth, development and senescence of plants. Plant hormones (auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, jasmonates etc.) and regulation gene expression. Tissue culture of plants. Vernalization, flowering, fruiting and diurnal cycles of plants.

Literature:

Taiz, L., Yeiger, E. (1998) Plant physiology. Sinauer Associates Inc., Publishers, Sunderland, Massachusetts.

TBBL0105 PLANT PHYSIOLOGY PRACTICALS I.

Practicals: 2
Credits: 1
Examination: oral and written
Lecturer: Ilona Mészáros associate professor and George Borbely professor

Students choose experiences in hands-on laboratory techniques in aspects of modern plant approaches, including plant cell and molecular biology. Department's research facilities advanced microscopy equipments; separation techniques etc. will support education and research. Botanical garden, a greenhouse and a tissue culture room supports work in plant metabolism and physiology.

Literature:

Departmental hand-outs on Plant Physiology I.

TBBE0110 BIOGEOGRAPHY

Lectures: 2
Credit: 3
*Examination:*oral
Lecturer: Attila Molnár V. senior lecturer

Aims: The course intends to introduce students to biogeography, the science which deals with patterns of species distribution and the processes that result in such patterns. The patterns of species distribution at this level can usually be explained through a combination of historical factors such as speciation, extinction, continental drift, glaciation (and associated variations in sea level, river routes, and so on), and river capture, in combination with the area and isolation of landmasses (geographic constraints) and available energy supplies.

Short description of the course: Basic concepts in biogeography: flora, fauna, vegetation, faunation, coenosis, zoocoenosis, migration, colonisation, dispersal, biodiversity. Main flora bioregions of the World (Palearctic, Nearctic, Paleotropic, Neotropic, Antarctic regions) and their characterisation and description; main fauna bioregions of the World (Palearctic, Nearctic, Paleotropic, Neotropic regions), and their characterisation and description. The European biogeographical regions (Alpine, Anatolian, Arctic, Atlantic, Black Sea, Boreal, Continental, Macaronesia, Mediterranean, Pannonian, Steppic) and its divisions. The floristic classification of the Carpatho-Pannonian region. The faunistic division of the Carpatho-Pannonian region. The formation of modern Biota with special emphasis on the role of Ice Ages. Phylogeography, insight to biogeography from genes.

Literature

AVISE, JC 2000: *Phylogeography. The History and Formation of Species*. Harvard University Press, Cambridge.
GASTON, K.J. 2000: Global patterns in biodiversity. *Nature* 405: 220–227.

HEWITT GM (1999) Post-glacial re-colonization of European biota. *Biological Journal of the Linnean Society* 68**:** 87-112.
HEWITT GM (2000) The genetic legacy of the Quaternary ice ages. *Nature* **405**: 907-913.
HEWITT GM (2000) Speciation, hybrid zones and phylogeography – or seeing genes in space and time. *Molecular Ecology* **10**: 537-549.
UDVARDY, M. 1969: *Dynamic Zoogeography, with Special Reference to Land Animals.* Illustrated by Charles S. Papp. – Van Nostrand, New York. 445 pp.
Periodicals: *Journal of Biogeography*, *Global Ecology and Biogeography*, *Diversity and Distributions*.

TBBE0205 ANIMAL PHYSIOLOGY I
Lectures:2
Credits: 3
Examination: oral midterm
Lecturer: Gaspar Banfalvi professor

Aim of the course*:* This subject gives a comprehensive view regarding the function of the animal and human organism and the regularities of the life-functions. It provides fundamentals for high school teachers to be and for those who decide to do research.
The course involves: The laws of dilute solutions, the buffer systems of organisms. The evolution of osmotic systems. Homeostasis. Extra- and intracellulaer fluids. Diffusion and active transport across cellular membranes. Oxygen transport. Blod coagulation. Circulation of body fluids, the heart. The pacemaker and excitation potential of heart. Circulatory systems (open, closed). Types of pumps. Circulation of blood in fish, amphibians, reptiles, birds, mammals. Respiration in water and air. Evolution of food and energy utilization, digestion, absorption, excretion.
Literature:
Knut Schmidt-Nielsen: Animal Physiology, Cambridge University Press, 1997.

TBBL0205 PRACTICALS OF ANIMAL PHYSIOLOGY I
Practicals: 2
Credits: 1
Examination: written
Lecturer: Gabor Nagy lecturer

Aim of the practicals*:* To give an insight into classical and modern methods of physiology and how these methods work. To get sufficient practical and theoretical knowledge to plan and execute your own experiments.
The practicals involve*:* Characterization of the properties of blood: hematocrit, haemoglobin content, determination of bleeding time, coagulation time, blood groups, Rh groups, blood-stain. Analysis of cellular components of blood, the osmotic properties of blood, staining blood smears, determining the number of red blood cells. Blood circulation and studies on heart: the circulatory system of amphibians, *in situ* heart of the frog, registration of the spontaneous function of the blood. Stannius ligature. Electrocardiographic examination of the human heart. Measuring blood plessure. Pletismography. Computer simulated examinations.
Literature:
Departmental hand-outs on Animal Physiology.

TBBE0210 HUMAN BIOLOGY

Lectures:2
*Credit:*3
Examination: oral
Lecturer: László Szathmáry associate professor

Aim: to teach ontogenetic and phylogenetic evolution of humans.
Short description of the course: Constitution of the human body, with particular emphasis on the anatomy of the skeleton and the teeth. Quantitative and qualitative characteristics of the body and the skeleton. Ontogenetic and phylogenetic tendencies during the intrauterine development and the postnatal period. Dermal ridges system. Basic biometrical studies. The bases of biodemography. Structures of human populations and their changes. Natality, fertility, mortality, migration and reproduction. Rudiments of human genetics. Genetic types. Classification of human chromosomes. The importance of mutation (gene-, chromosomal and genom-mutations) and selection. Anthropological aspects of physiological characteristics. The bases of human population genetics. An outline of sub-human and human evolution. Cultural evolution of Man. Evolution and taxonomy of recent populations, with special regard to the Carpathian Basin.
Literature:
Aiello, L., Dean, C. (1990): An Introduction to Human Evolutionary Anatomy. Academic Press, Harcourt Brace Janovich, Publishers London, San Diego, New York, Berkeley, Boston, Sydney, Tokyo, Toronto.
Lasker, G. W. (1973): Physical Anthropology. Holt, Rinehart and Winston, Inc. New York, Chicago, San Francisco, Atlanta, Dallas, Montreal, Toronto, London, Sydney.
Wolpoff, M. H. (1996-1997): Human Evolution. The McGraw-Hill Companies Inc. New York, St. Luis, San Francisco, Auckland, Bogotá, Caracas, Lisbon, London, Madrid, Mexico, Milan, Montreal, New Delhi, Paris, San Juan, Singapore, Sydney, Tokyo.

TBBE0215 EVOLUTIONARY BIOLOGY AND POPULATION GENETICS

Lectures: 2
Credits: 3
Examination : written and oral
Lecturer: Katalin Pecsenye associate professor

Aims of the course: To analyse the genetic consequences of various microevolutionary processes and to study the most important rules of evolution.
The subject of the course: Levels of variation in natural populations: morphological and molecular variation. Short history and relevant ideas in Evolutionary Biology. The transformists, Lamarck and neo-lamarckism; Darwin, the idea of Natural Selection by Survival of the Fittest and the beginnings of Population thinking; the Neo-Darwinists and the "evolutionary synthesis": R. Fisher, S. Wright, Haldane, Chetverikov, Dobzhansky, Huxley, Mayr, Simpson etc.; the Post-Synthetic period.
Population Genetics: The role of Population Genetics in modern evolutionary thinking and research. Genetic equilibria in ideal populations, the Hardy-Weinberg rule. Random and non-random mating, inbreeding, outbreeding, meiotic drive, recombination, maternal and sex-linked heritage. Mutation in populations, mutation rate and pressure. Selection in populations, viability and fertility, absolute and relative fitness, mutation-selection equilibria, types of dominance and selection, Fisher's fundamental theoremGenetic drift and Wright's shifting balance theory, founder effect, effective breeding size and bottlenecks. . The genetic load, theory of "neutral" evolution. Migration, isolation, subdivision, metapopulation structure and

gene-flow. Levels of genetic variability in natural populations, components of phenotypic variance, heritability. Chromosomal polymorphism: inversions and Robertsonian fusions. Polymorphism in Mendelian phenotypic characters; maintenance of polymorphism by frequency-dependent, overdominant and disruptive selection: Batesian and Mullerian mimicri; allozyme polymorphism; polymorphism at DNA-level (RFLP and PCR technics, restriction fragments, microsatellites, mitochondrial DNA), measures of molecular polymorphism and genetic distance; phylogeographic analysis. Genetic processes in structured populations, group and kin selection, the "female choice" principle and sexual selection. Evolutionary stable strategies, game theoretical models. Competition and co-evolution.
Facts and Theories on Evolution: Measures of genetic diversity within and between taxa. The biospecies concept in evolutionary context. Isolation, recognition and cohesion criteria. Types of reproductive isolation and case studies. Specific mate recognition systems; reproductive behaviour, pheromones, character displacement. Genetic mechanisms and modes of speciation: Robertsonian and Darwinian phase, polyploidy and speciation. Synpatric and stasipatric speciation, cases of rapid evolution. Allopatric speciation: the "dumbbell" modell, vicariance and speciation at different levels; quaternary speciation in glacial refugia, case studies. The peripatric modell of speciation. Founder effects and speciation. Incomplete reproductive isolation: the semispecies. The genetic and taxonomical structure of polytypic species and superspecies; hybridisation of geographical races and closely related semispecies/species. Cladistic analysis of speciation. Anagenesis and cladogenesis. Adaptive radiation, its relevance in insular faunas and in resource partitioning of new adaptive zones. Adaptive radiations in Tertiary and Quaternary history of biota: case studies. Gradualistic and punctuationalistic ideas in evolutionary theory, palaeontological evidences. Changes of global Biodiversity during the Earth's history. The evolution of the Biosphere: trends and cyclic processes. Problems of mass extinctions. Past, present and future perspectives of human evolution. The evolutionary episthemology.

Literature:

Hartl, D.L. 2000. A primer of population genetics. 3 ed. *Sinauer Associates, Sunderland*
Literature: Futuyma, D. J. 1989. Evolutionary Biology. Sinauer Ass., Massachusetts.
Maynard Smith, John 1989. Evolutionary Genetics. Oxford University Press
Ridley, M. 1996. Evolution. Blackwell, Cambridge
Roughgarden, J. 1979, Theory of Population Genetics and Evolutionary Ecology. MacMillan, New York
Weir, B. S. 199O. Genetic Data Analysis. Sinauer Associates, Sunderland, Massachusetts
White, M. P. D. 1987. Modes of Speciation. Freeman, San Francisco

TBBE0220 ETOLOGY

Lectures:2
*Credits:*3
Examination: written and oral
Lecturer: Barta Zoltan associate professor

Aims: During the course we will pursue three objectives. First, we will get some insight on the huge variation in animal behaviour. Second, we will investigate how within individual mechanisms (e.g. physiology, neuroendocrine system or genetics) can generate this behavioural variation. Third, we will study the evolutionary factors shaped this variaton.

Topics of the course: During the course we will deal with the following topics: The definition of behaviour. The basic questions of begavioural biology research. A short history of behavioural biology. The mehanism behind behaviour: controll and decision making,

stimuli, motivations. The ontogeny of behaviour: the effects of the genes and the environment. Learning and animal inteligence. The theory of natural selection and the unit of selection. Optimality modelling in behavioural ecology: classical and game theoretical optimalization. Sexual reproduction, sexual selection. Mating systems, parental care. Living in groups, eusociality. The sociobiology of human behaviour.

Literature:

Alcock, J. 2005. Animal behaviour. An evolutionary approach. Sinauer Associates

Bolhuis, J. J. & Giraldeau, L.-A. (eds) 2004. The behavior of animals. Mechanism, function and evolution. Blackwell Publishing.

Dawkins, R. 1976. *The selfish gene*. Oxford University Press, Oxford.

Ridley, M. 2003. *Evolution*. Backwell Publishing, Third edition. Backwell Publishing.

TBBE0401 GENETICS I

Lectures: 3
Credits: 4
Examination: written
Lecturer: Matthias Sipiczki professor

Aims and topics: The material of heredity. The organisation of DNA and RNA. The prion. Organisation of DNA in chromosomes. Karyotypes. Chromosome complements. Euploids and aneuploids. Autoploids and alloploids. Replication, transcription and posttranscriptional modifications. Mutation and repair. Alternation of generations. Meiosis and neocombination. Mendelian genetics. Dominant inheritance, recessive inheritance and intermediary inheritance. Codominance and epistasis. Pleiotropy and polygenic determination. Expressivity and penetrance. Inbreeding and heterosis. Genetics of sex determination. The X-Y, W-Z, X-O and haploid-diploid sex-determining mechanisms. Parasexuality. Sex-linked inheritance. Problem solving.

Literature:

Griffiths A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., Gelbart, W.M.: Genetic Analysis.Freeman and Company, New York,1999
Brown, T.A.: Genomes. BIOS Scientific Publishers Ltd. 2002
Reece, R.J.: Analysis of Genes and Genomes. John Wiley and Sons., Chichester, 2004

TBBE0505 GENERAL MICROBIOLOGY

Lectures:2
Credits:3
Examination: written
Lecturer: István Pócsi associate professor

Aims of course: The students will become familiar with basic concepts of general microbiology, which will support subsequent courses satisfactorily in the fields of microbial ecology, industrial microbiology and medical microbiology.

Lectures: Emphasis will be put on the historical development of microbiology and basic concepts of microbial physiology. We are also deaking with the latest achievements in the area of microbial taxonomy; The book of Bergey's Manual of Systematic Bacteriology, Second Edition is recommended as a standard in bacterial taxonomy. We make an effort to set up a well-balanced curriculum supporting later claims of students to reach versatile, multi-direction specialisations in this field. Main topics to be covered: a historical review of microbiology, basic concepts, general characteristics of microorganisms. Microbes of the

domains of *Bacteria*, *Archaea* és *Eukarya* – a general and comparative cytological and physiological approach. Metabolism and biochemistry of microorganisms. Detailed bacteriology: most important taxa of prokaryotes belonging to the domains of *Archaea* and *Bacteria* (phyla *Deinococcus - Thermus*, *Chloroflexi*, *Chlorobi*, *Cyanobacteria*, *Chlamydiae*, *Spirochaetes*, *Spirochaetes*, *Proteobacteria*, *Firmicutes* és *Actinobacteria*), including the presentation of type genera and species. The most important human and plant viruses and bacteriophages. Human pathogenic prions and protozoa.

Literature:

1. Emri, T., Pusztahelyi, T., Leiter, É., Lenkey, B., Pócsi, I.: General Microbiology, in preparation
2. Prescott, L.M., Klein, D.A. John P. Harley: Microbiology, 5th Edition, McGraw-Hill, Boston, 2002

TBBL0505 GENERAL MICROBIOLOGY PRACTICALS

Practicals:2
Credit: 1
Examination: written
Lecturer: Tamás Emri lecturer

Aim: The students will gain familiarity with respect to special safety regulations of microbiological laboratories, basic microbiological procedures (passages of strains, preparation and maintenance of strain collections, separation of mixed cultures into monocultures, preparation of micro-organisms for microscopic observation, simple biochemical tests to identify and characterize bacteria).

Literature:

1. Emri, T., Pusztahelyi, T., Leiter, É., Lenkey, B., Pócsi, I.: Microbiology laboratory practices, in preparation

TBBE0508 MYCOLOGY

Lectures:1
*Credits:*1
Examination: written
Lecturer: István Pócsi associate professor

Aims: The students will gain familiarity in basic general mycology, which will support later courses in the fields of microbial ecology, genetics, industrial microbiology and medical microbiology. The primary aim is to give the audience a comprehensive view on both microscopic and macroscopic fruiting body fungi.

Lectures: The course traditionally covers both true fungi (regnum Fungi) and fungus-like organisms (placed in regna Protozoa and Chromista), and concomitantly aims at giving an up-to-date knowledge to the students in modern fungal taxonomy. In addition, the following topics will be discussed in details: organisation of fungal thalli, reproduction, including sexual, asexual and parasexual propagations, dormancy and dispersion of fungal spores and specific aspects of fungal metabolism. Plant-fungus symbioses will also be presented together with the pathogeneses of the most important fungal diseases of plants, insects and human. Special attention will be paid to the presentation of the most important mycotoxins hazardous for human.

Literature:
1. Deacon, J.W.: Modern Mycology, 3rd Edition, Blackwell Science, Oxford, 1997
2. Kendrick, B.: The Fifth Kingdom, 3rd Edition, Focus Publishing, Newburyport, 2000

TBBL0508 MYCOLOGY PRACTICAL

Practicals:1
Credits:1
Examination: written
Lecturer: Tamás Emri lecturer

Aim: The practice will include the presentation of both the most important microscopic fungi and macroscopic fruiting bodies and, hence, will support effectively the Mycology course lectures. In the case of macrofungi, the course helps the students to gain basic skills in fungi recognition. About 20-25 microfungi species (important human and plant pathogenic species, stock house pathogens as well as laboratory model and test organisms) will be presented together with about 50-55 macrofungi species (the most important toadstools and edible fungi in Hungary). In addition to becoming familiar with the recognition of fungal species, the students will discuss the reproduction and life cycles of fungi, as well as their remarkable role in Nature and human life.
Literature:
Fungal taxonomy books currently available in Hungary.

TBBE0515 MOLECULAR BIOLOGY I

Lectures: 2h/week
Credits: 3
Examination: written
Lecturer: Ida Miklos associate professor

Aim: Molecular biology is one of the most rapidly moving areas of the life sciences. Therefore our aim is to give an overview about the basic methods of molecular biology and to present their application.
Topics: Introduction. Vectors. Features of different vectors and their application. Restriction enzymes.Generation of recombinant molecules. Transformation of *E. coli* cells. Isolation and purification plasmids from bacterial cells. Gel-electrophoresis. Working with yeasts, as useful model organisms. Pulsed field gel-electrophoresis. Amplification of DNA, PCR and real-time PCR. DNA sequencing and genome projects.
Literature: departmental hanouts

BASIC ECOLOGY

(TBBE0602 General Ecology) + (TBBE 0603, TBBG0603Applied Ecology)
Lectures: 2+0, 1+1
Credit: 3+2
Examination: written
Lecturer: Béla Tóthmérész and Gyula Lakatos

Aims of the course: The aims of this course are that students gain basic knowledge of the general and applied ecology, attain skill in fundamental methods of both ecological scientific

areas, useful for understanding the ecological theories and practices and apply them in their activities.

Lectures: Organisms and their Environments. Resources. Life, Death and Life Histories. Competition. Metapopulations. Species Interactions and Population Dynamics; Interspecific competition, predation. Decomposers and detritivores, parasitism and disease, symbiosis and mutualism. Communities and Ecosystems. Community patterns in space and time. The influence of population interactions on community structure. Food webs. Patterns in species richness. Elements of island biogeography**.**

Terminological system of applied ecology. Global environmental issues. Solar energy reaching the Earth. Energy used by people. The carbon cycle of the Earth, processes, amounts, rates. The greenhouse effect. Climate change. The ecology of food production. Phosphorus balance of farms. Fish from the fresh waters. Primary productivity and food chains. Systems of forest management. Invaders and pests.

Pollution. Ecological footprint. Movement of substances along food chain (bio-magnification). Principles of ecotoxicology. Using microcosms and mesocosms to study effect of pollutants on communities. Theories of bioremedation (phytoremediation). Heavy metal tolerance in plants. Methods of reducing the harmful effects of pollutants.

Conservation and management of natural values (wild species, vulnerable area). Species-area relationship. Monitoring ecological change. Environmental impact assessments and monitoring.

References

Begon, M., Harper J.L. and Townsend, C.R., 1990: *Ecology*. Blackwell, Oxford.

Harris, F. (ed.) 2004: *Global environmental issues*. John Wiley and Sons, Ltd., Chichester

Newman, E.I. 1993: *Applied ecology.* Blackwell Scientific Publications, London.

Spellerberg, J.F. 1993: *Monitoring ecological change.* Cambridge University Press, Cambridge.

TBBE0610 ENVIRONMENTAL PROTECTION

Lectures: 3
Credit: 3
Examination: written
Lecturer: Lakatos Gyula associate professor, K. Kiss Magdolna lecturer

Aims of the course: The student have knowledge based on ecology and environmental elements in the activities of the environmental protection. The student should be able to understand the treatment of polluted air, soil and water, as well as the most important tasks on the area of the environment protection and nature conservation.

Short description of course: Water resources and management. Integrated water management. Criteria and standards of water quality. Public water supplies, drinking water. Inorganic chemicals. The nature and types of organic pollutants. Tastes and odors in drinking water. Removal of inorganic and organic chemicals from the drinking and industrial waters. Removal of algae, pathogenic bacteria and viruses.

The environment and pollution. Ecological effects of wastewater. Predicting the environmental fate of pollutants. Biodegradation of organic compounds. Wastewater treatment chemistry and microbiology. Activated sludge process. Bulking and foaming in activated sludge plants. Processes based on attached microbial biofilm. Waste stabilization ponds. Anaerobic treatment of wastewater and sludge. Energetics and technology of biological elimination of wastes. Bio-gas production.

Removal of nitrogen and phosphorous. Constructed wetlands for wastewater post-treatment. Eutrophication and treatment of eutrophicated waters. Bio-manipulation. Treated wastewater reuse.
Antropogenic air pollution. Protection of air. Major air pollutants. Smogs (London-type and photochemical). Impacts of different chemicals, pesticides and fertilizers. Soil pollution. Organic and inorganic pollutants in soil. Environmental problems of industrial activities. Renewable and fossile energy sources. Accumulation and degradation of artificial chemicals (xenobiotics) in environment. Types of waste and waste management. Environmentally saving technologies. Clear technology. Pollutants of traffic. Noise pollution.

Acidification, greenhouse effect, ozone depletion, decreasing of water supplies and biodiversity as important global environmental problems.
Global problems of environment. Overpopulation, nutrition, decline of row material sources, energy utilization and environmental protection.

References:

Harris, F. (ed.) 2004: *Global environmental issues*. John Wiley and Sons, Ltd., Chichester
Hester, R.E., Harrison, R.M. (eds.) 2002: *Global environmental change.* Royal Society of Chemistry, London
McEldowney, S., Hardman, D.J., Waite, S. 1994: *Pollution: ecology and biotreatment*. Longman Scientifi and Technical, Singapore
Mitchell B. 1990: *Integrated water management.* Belhaven Press, A Division of Pinter Publishers, London

TBBE0615 NATURE CONSERVATION

Lectures:2
*Credits:*3
Examination: written and oral
Lecturer: Albert Tóth senior lecturer

Aims: The course is intended to describe the scientific basis and practice of nature conservation, with emphasis on the ecological aspect.
Short description of the course: Nature conservation and environment protection. A historical overview of conservation activities. Objectives and tools of nature conservation. Principles and the ethical codex of present-day conservation biology. Conservation policy, legislation and institutional settings in Hungary. Practice of n.c. in Hungary.
Biodiversity as information and its quantification. Diversity, stability, productivity and resilience of communities. State survey and evaluation of communities and habitats. Biodiversity monitoring, habitat classification, near-natural state and degradation. Conservation measures on the habitat and the species level. The role of nature conservation in utilized landscapes. Conservation priorities in farmed land, habitat fragmentation, river and green corridors. Habitat preservation, conservation, rehabilitation, reconstruction, creation. Conservation management. Conservation of genetic resources, off site techniques. Protected species and cultivars. Nature conservation and sustainability. International conventions and regulations. Classification of nature reserves (IUCN categories and NP zonation). Conservation policy, legislation and funding in the EU.

Literature:

Bryant, P.J.: Biodiversity and Conservation (Hypertext Book, School of Biological Sciences, University of California, Irvine), http://darwin.bio.uci.edu/~sustain/bio65/Titlpage.htm
Figeczky, G. 2006: Europe's Living Countryside – promoting policies for sustainable rural development. The Hungary National Report, WWF – SNM – LUPG, 60 pp.

Primack, R.B. 2004: A Primer of Conservation Biology (3rd edn.). Sinauer Associates Inc., Sunderland, MA, USA, 320 pp.

MODUL IV. SUBJECTS OF ADVANCED PROFESSIONAL TRAINING

TBBE0106 PLANT PHYSIOLOGY II.
Lectures: 2
Credit: 2
Examination: written
Lecturer: György Borbély professor

Aim: Plant physiology has changed remarkably in the last decades. The modern plant physiologist is interested in what goes on inside the plants, how it grows, how it is adapted to its environment, what parts of crop plants actually contribute to their yield etc. Plant physiology is therefore an experimental subject. This course ranges from experimental molecular plant cell biology to plant biotechnology.
Short description of the course: Planning plant physiological experiments and the description of their basic methodological approaches. Biochemical and molecular biological addressing of plant physiological problems. Light dependent gene expression of plants. Structure and functions of plant genes. Phytochromes and their role in photoreception and sensing photoperiod. Regulation of plant growth and development, a molecular approach. Plant organ (root, stem, flower, inflorescence, seed) development and regulatory and genetic processes of plant organ differentiation. Cell division and signal transduction in plants. Receptor physiology. Cell cycle regulation. Plant genomics and proteomics. Plant responses to pathogens (viruses, bacteria, fungi), plant defense system. The importance of cell and tissue culture systems in transgenic plant production. *Agrobacterium* mediated T-DNA transfers and vector system responsible for gene transfer. Physiology and biochemistry of plant diseases.
Literature:
Taiz, L., Yeiger, E. (1998) Plant physiology. Sinauer Associates Inc., Publishers, Sunderland, Massachusetts.

TBBL0105 PLANT PHYSIOLOGY PRACTICALS II.
Practicals: 2
Credits: 1
Lecturer: Ilona Mészáros associate professor and George Borbely professor
Examination: oral and written

Short description. Students choose experiences in hands-on laboratory techniques in aspects of modern plant approaches, including plant cell and molecular biology. Department's research facilities advanced microscopy equipments, separation techniques etc. will support education and research. Isolation of plant organelles (chloroplasts, nuclei, mitochondria). Preparation of plant protoplast, regeneration of plant tissues, *Agrobacterium* mediated plant transformation. Preparation, purification and characterization plant macromolecules proteins, enzymes and nucleic acids (DNA and RNA, cellulose, polysaccharides, lignins - suberation).
Literature:
Departmental hand-outs on Plant Physiology I.

TBBE0206 ANIMAL PHYSIOLOGY II
Lectures:1
Credits: 1
Examination: oral final exam
Lecturer: Gaspar Banfalvi professor

Aim of the course: The course summarizes the structural and functional differences of animal and human physiology and regulatory processes of life functions. It contributes to the independent individual study of the subject.
The course involves: Excretion, vertebrate kidney. Structural and functional characterization of the nephron. The neuronal and hormonal regulation of the kidney. Components of gene regulation. Types of signal molecules. Primary and secondary receptors. The feed-back regulation of the endocrine system. Endocrine glands. Hormones. Glucose metabolism in different tissues. Hormonal regulation of blood glucose. Three basic mechanism of motion. Muscle, biomechanics. Evolution of organs involved in motion. Neuromuscular junctions. Information and senses. Structural and functional properties of receptors. Central nervous system. Development of brain. Neuronal connections. Peripheral nervous system. Structure and function of the neuron. Neuronal activity.
Literature
Knut Schmidt-Nielsen: Animal Physiology, Cambridge University Press, 1997.

TBBL0206 PRACTICALS OF ANIMAL PHYSIOLOGY II
Practicals: 2
Credits: 1
Examination: written
Lecturer: Gabor Nagy lecturer

The practicals involve*:* General characteristics of feeding. Fermentative properties of the human saliva. Protein digestion with pepsin extraction. Investigating the kidney: components of urine, computer simulation. Hormonal experiments: gravidity test, hormones influencing blood sugar level. Physiological experiments related to vision (blind spot, optical errors, colour-blindness, visual field), voice (audiometry), sensation of touch, pressure. Experiments on nerve, muscle and sensation using frog nerve-muscle preparation. Simulation of nerve action potential.
Literature:
Departmental hand-outs on Animal Physiology.

TBBE0402 GENETICS II
Lectures:1
*Credit:*1
Examination: written
Lecturer: Matthias Sipiczki professor

Short description of course: Crossing-over, gene conversion and post-meiotic segregation. The molecular mechanism of recombination. Mitotic recombination. Mobile genetic elements, insertion sequences, transposons, retroelements. Transformation. Transduction. Plasmids and episomes. Extrachromosomal inheritance. Introduction to genetic engineering.

Literature:
Griffiths A.J.F., Miller, J.H., Suzuki, D.T., Lewontin, R.C., Gelbart, W.M.: Genetic Analysis.Freeman and Company, New York,1999
Brown, T.A.: Genomes. BIOS Scientific Publishers Ltd. 2002
Reece, R.J.: Analysis of Genes and Genomes. John Wiley and Sons., Chichester, 2004.

TBBG0402 SEMINARS IN GENETICS II
Lectures:1
*Credit:*1
Examination: written
Lecturer: Matthias Sipiczki professor

Short description: Problem solving in genetics. Microscopic examination of the structure of the nucleus. Methods of mutagenesis, mutant isolation and the examination of the mutant phenotype. Hybridisation and segregation. Genetic mapping by recombination. Basic techniques of genetic engineering.

Literature
Kowles, R.: Solving Problems in Genetics. Springer, New York. 2001.
Korf. R. Bruce: Human Genetics. A problem-based approach. Blackwell Science, Massachusetts, 2000

TBBE0410 INTRODUCTION TO BIOINFORMATICS
Lectures: 1
*Credit:*1
Examination: written
Lecturer: Matthias Sipiczki professor

Aims and short description of the course: Finding and retrieving nucleotide sequences and amino acid sequences in databases. Identification of genes in nucleotide sequences. Identification of introns and exons. Prediction of gene functions and annotation. Detection of sequence similarity by sequence alignment. pairwise and multiple alignment. Alignment algorithms. Global and local alignment. Similarity searching by heuristic programmes. BLAST and FASTA. Hidden Markow models. Finding conserved elements. Prediction of secondary structures. Internet resources for geneticists.
Literature*:*
Lesk, A.M.: Introduction to bioinformatics. Oxford University Press, Oxford, 2002
Barnes, M.R., Gray, I.C.: Bioinformatics for geneticists. John Wiley and Sons Ltd. Chichester, 2003

TBBE0503 CELL BIOLOGY II
Lectures: 1
Credits: 1
Examination: oral
Lecturer: Gaspar Banfalvi professor

Aim and short description of the course*:* To get an up-to-date molecular knowledge on the processes involved in the connected processes of transfer of cellular information: DNA replication, recombination, mutation, repair, malignant transformation, apoptosis, transcription, reverse transcription, RNA replication, posttranscriptional modification, translation, posttranslational modification, protein targeting. Enzymes used in recombinant techniques, cloning, DNA library, polymerase chain reaction. Cell lines of haemopoesis, markers of lymphocyte cell populations, macrophages and their functions. HIV infection. The structure and function of Ig molecules. Citokines. Complement system.
Literature:
Alberts, B., Johnson A., Lewis, J., Raff, M., Roberts, K and Walter, P.: Molecular Biology of the Cell. 4th Edn. Garland Publishing, Inc. New York.

TBBL0503 PRACTICALS OF CELL BIOLOGY II
Lectures: 2
Credits: 1
Examination: written
Lecturer: Gabor Nagy lecturer

Aim of the practicals*:* Providing basic knowledge in microscopy (light, fluorescence, electronmicroscopy), cell structure, cell cultures, cytometry, cytochemistry.
The practicals involve: Microscopic analysis of the interphase cell. Characterization of cell populations. Cytochemic reactions: nucleic acids, carbohydrates, localization of enzymes in the cell. Properties of interphase and mitotic cells. Analysis of chromosomes. Growth of transformed cells. Electronmicroscopic analysis of the fine structure of the cell.
Literature:
Departmental hand outs on Cell Biology.

TBBE0506 MICROBIOLOGY II

Lectures:1
Credit: 1
Examination: oral
Lecturer: István Pócsi associate professor

Aim: The Microbiology II course, which relies on preceeding biochemical, microbiological and mycological courses, let the students to become specialized in the fields of biotechnology, molecular biology and bioengineering to get a deeper insight to the basically important biochemical and physiological processes of microorganisms. This course supports further courses in the field of microbial physiology, biotechnology, fermentation technology.
Short description of the course: The course covers the exoenzyme production of bacteria and fungi, the transport systems of microorganisms, the most important anabolic and catabolic processes as well as the introduction of the most important groups of secondary metabolites. The biosynthesis of bacterial and fungal cells walls will receive a special attention. In each topic, we intend to reach a complex, multi-faceted demonstration of the selected biochemical and physiological processes paying attention to bioenergetic considerations and regulatory mechanisms. After introducing metabolic pathways, we shall also present the most important global regulatory networks and signal transduction pathways in both prokaryotes and fungi. Finally, the molecular background and regulation of bacterial chemotaxis, sporulation and cell differentiation will also be discussed.

Literature:
1. Emri, T., Pusztahelyi, T., Leiter, É., Lenkey, B., Pócsi, I.: General Microbiology, in preparation
2. Jakucs, E., Vajna L.: Mikológia, Agroinform Kiadó, Budapest, 2003
McGraw-Hill, Boston, 2004
3. Lengeler, J.W., Drews, G., Schlegel, H.G.: Biology of the Prokaryotes, Georg Thieme Verlag, Stuttgart, 1999
4. Gow, N.A.R., Gadd, G.M.: The Growing Fungus, Chapman&Hall, London, 1995

TBBL0506 MICROBIOLOGY II PRACTICALS
Practicals:2
Credit:1
Examination: written or oral
Lecturer: Tamás Emri lecturer

Short description: Students will become familiar with microbiological measurements through a selection of complex examples including minimal inhibitory concentration (MIC) determinations, measurements of specific growth rates, development and selection of mutants, Aims-test. Evaluation of data and basic statistics. The students are required to be able to perform and discuss microbiological measurements independently. The students will look through basically important metabolic processes and regulations as well as will become experienced in bioenergetic calculations.
Literature:
Emri, T., Pusztahelyi, T., Leiter, É., Lenkey, B., Pócsi, I.: Microbiology laboratory practice, in preparation.

TBBE0511 BIOTECHNOLOGY

Lectures:1
Credit: 1
Examination: written
Lecturer: István Pócsi associate professor

Aims of course: The students become familiar with basic concepts of general biotechnology, which will support later courses in the fields of molecular biology, biotechnology and bioengineering.
Short description: The students will learn basic concepts of biotechnology and will get a deeper insight in the different branches of the discipline including the social, legal and economic aspects of biotechnological research. Major topics: basic fermentation technology, bioreactor engineering, measurement and process control, downstream processing; production of the most important microbial primary (organic acids, amino acids) and secondary (aminoglycosides, β-lactams) metabolites – physiological and genetic background; microbial enzyme production and use; micro-organisms in bioconversions (steroids, semi-synthetic penicillins, vitamin C); biomass and ethanol production; a summarization of the most important food biotechnology processes; heterolog enzyme production in bacteria and yeasts (chymosin, insulin, hepatitis B surface antigen); biotechnology and medicine – recombinant vaccines, mammalian cell cultures, artificial tissues, stem cells; agricultural, forestry and plant biotechnology, production of GMO plants and animals; environmental biotechnology – waste water treatment, decomposition of xenobiotics, bioremediation; micro-organisms in mining, cleaning heavy metal pollutions. In the whole course, priority will be given to "new" biotechnological practices relying in recombinant DNA technology.

Literature:
Ratledge, C., Kristiansen, B. Basic Biotechnology, Cambridge University Press, Cambridge, 2001.
Smith, J.E. Biotechnology, Cambridge University Press, Cambridge, 2004

TBBE0516 MOLECULAR BIOLOGY II

Lectures: 1h/week
Credits: 1
Examination: written
Lecturer: Ida Miklos associate professor

Aim: Our aim is to broaden the knowledge in molecular biology and to overview those methods, which were not discussed in part I.
Topics: Generation of gene library. RNA isolation. cDNA library. Hybridisation, Southern- and Northern blot. Isolation and purification of proteins. Localisation of proteins in the cells.
Literature:
Robertson D, Shore S., Miller D.: Manipulation and expression of recombinant DNA, Academic Press, London, 1997.
Sabrook J., Fritsch E.F., Maniatis T.: Molecular Cloning, Cold Spring Harbour Laboratory Press, 1989.
Cooper G.M.:The Cell, ASM Press, 2000.

TBBL0516 PRACTICALS IN MOLECULAR BIOLOGY II

Lectures: 2h/week
Credits: 1
Examination: written
Lecturer: Ida Miklós associate professor

Topics of the practical courses: Transformation of E. coli cells. Isolation of genomic and plasmid DNA. Digest with restriction enzymes. Gel-electrophoresis. Pulsed-field electrophoresis. Isolation of DNA from gel.; Transformation of yeast cells. DNA isolation from yeasts. PCR reactions. Real-time PCR reactions. Hybridisation.
Literature:
Robertson D, Shore S., Miller D.: Manipulation and expression of recombinant DNA, Academic Press, London, 1997.
Sabrook J., Fritsch E.F., Maniatis T.: Molecular Cloning, Cold Spring Harbour Laboratory Press, 1989.
Cooper G.M.:The Cell, ASM Press,2000

TBBE0620 PLANT ECOPHYSIOLOGY

Lectures: 2 h/week
Credits: 2
Examination: written
***Lecturer*:** Ilona Mészáros associate professor

Aim and short description of the course: Environmental resources and physiological tolerance of plants. Adaptation and acclmatization of plants. Physiological traits of Grime'

plants strategies. Productivity and carbon balance of plants. Relationship between carbon balance, growth and allocation processes. Plant growth analysis. Environmental factors and photosynthesis. Plant responses to light. Sun and shade plants. Photoinhibition, photoprotection and photodamage. Chlorophyll fluorescence and plant stress. Gas exchange of plants. Evolution and distribution of C4 and CAM plants and C3-C4 intermediates. C3, C4 and CAM plants and water-use efficiency. Specialised mechanisms associated with photosynthetic carbon aquisition of aquatic plants. Water availability in the soil and plant water relations. Physiology of poikilohydric and homoiohydric plants. Pysiology and distribution of xerophytes, glycophytes and halophytes. Acclimation to water stress and regulation of stomata. Availability of nutrients and mycorrhizal fungi. Competition for nutrients.
Effects of environmental factors on secondary metabolism of plants, carbon/nutrient balance (CNB) hypothesis and growth/differentiation balance (GDB) hypothesis. Allelochemicals and competition. Productivity and ecophysiological traits of palnts in extreme habitats. Effects of environmental stress factors on plants (drought, flooding, temperature extremes, air pollutants, heavy metals, UV-B radiation). Influence of elevated atmospheric CO_2 on plants. Global climate change and vegetation effects. Field and laboratory methods in plant ecophysiology.

Literature:

Lambers, H., Chapin III, F.S-, Pons, L.T. 1998: Plant Physiological Ecology. Springer. New York-Berlin-Heidelberg.
Hall, D.O., Scurlock, J.M.O., Bolhár-Nordenkampf, H.R., Leegood, R.C., Long., S.P. 1993: Photosynthesis and Production in a changing environment. A field and laboratory manual. Chapman & Hall.London-Galsgow-New York-Tokyo-Melbourne-Madras.
Roger, M.J.R 2001: Handbook of plant ecophysiology techniques. Kluwer Acad. Publ. Dordrecht-Boston-London.

TBBL0620 PLANT ECOPHYSIOLOGY PRACTICALS
Practicals: 2
Credits: 2
Examination: written
Lecturer: Ilona Mészáros associate professor

Short description of the course: The students will gain experience in field and laboratory methods in plant ecophysiology. Measurements of plant biomass and net primary production of plants. Methods on measuring stomatal frequency, width and openess. Methods on measurements of plant water relations (relative water content, water potential, transpiration, stomatal resistance) in the field and in the laboratory. Sap flow measurements. Analysis of chloroplast pigments and pigment-protein complexes. Measurement of CO_2 assimilation by plants in the field and in the laboratory. Infra-red analysis. Analysis of light response and CO_2 response. Measurement of photosynthetic efficiency with polarography. Analysis of variation in carbon isotope discrimination among plants: sample preparation and purification and mass spectrometry. Analysis of chlorophyll fluorescence and screening of plant stress.

Literature:

Hall, D.O., Scurlock, J.M.O., Bolhár-Nordenkampf, H.R., Leegood, R.C., Long., S.P. 1993: Photosynthesis and Production in a changing environment. A field and laboratory manual. Chapman & Hall.London-Galsgow-New York-Tokyo-Melbourne-Madras.
Roger, M.J.R 2001: Handbook of plant ecophysiology techniques. Kluwer Acad. Publ. Dordrecht-Boston-London.

TBBE0640 SOIL SCIENCE
Lectures: 2h/ week
Credits: 2
Examination: written
Lecturer: Ilona Mészáros associate professor

Short description of the course: Processes of soil genesis. Weathering of rocks and development of clay minerals. Mineral particles in soils. Structure and traits of clay minerals and sesquioxides. Organic materials in soils. Decomposition and mineralization of dead organic matter and formation of humus. The structure and chemistry of humic substances. Terrestrial and aquatic humic substances. The arrangement of particles and pores, the soil structure. Porosity and the swelling and shrinking of soils. Water in soils. Soil water potentials and plant availability of water. Water budget of soils. Air in soils. The activity of microbial biomass in soil. Redox potential of soils. Particle surfaces. The colloids of soils and interaction with the soil solution. Formation of charged sites on the surface of humus and minerals. Surface charges and the adsorption and exchange of cations and anions. Base saturation of soils. Composition of soil solution. pH of soils. The chemistry of acidity and alkalinity in soils. The buffer capacity of soils. The availability of plant nutrients. Macronutrients and micronutrients. Soil fertilization and effects on soil chanistry. Soil salinity and sodicity. Soil contaminants (heavy metals and pesticides). Classification of soils. Description of major soil types of the Earth and the geographic distribution.
Literature:
Rowel, D.L. 1994: Soil Science. Methods and Applications. Longman Ltd. Essex.

TBBL0640 SOIL SCIENCE PRACTICALS
Practicals: 1
Credit: 1
Examination: written and oral
Lecturer: Ilona Mészáros associate professor, Albert Tóth senior lecturer

Short description of the practicals: Students will gain practice in laboratory methods on soil chemical and physical traits. Introduction to techniques for measuring pH, alkalinity, available forms of plants nutrients (e.g. inorganic nitrogen forms, phosphorus) and humic substances of soil. Measurement of buffering capacity of different soil types. The determination of lime requirement. Methods for measuring and expressing soil water contents. Soil water holding capacity. Measurements of respiration rates, carbon loss and temperature effects. Soil texture and particle-size analysis.
Literature:
Rowel, D.L. 1994: Soil Science. Methods and Applications. Longman Ltd. Essex.

TBBE0625 INTRODUCTION TO BIOMETRY

Lectures: 1h/ week
Credits: 1
Examination: written
Lecturer: Zoltán Barta associate professor

Aims. During the course we will study the basic principles of statistical analyses of biological data, the statisticaly valid design of simple but realistic experiments, and their analyses. After

the course you will be able to design and evaluate a small to medium volume research project.

Short description of the course. The steps of investigations in natural sciences. Why do we need biometry? Design of experiments: principles, elements, and limits of experiments, main types of experimental designs. Some probability theory: random variables and their distributions. Statistical description of data: tables, graphs and descriptive statistics. Hypothesis testing, decision making, type I and II errors. Parametric tests. Analyses of variance. General linear models. Non-parametric tests, contingency tables. This course is complemented by a practical where we will put great emphasis on practical use of the statistical procedures and will use the R statistical environment.

Literature:

Sokal RR és Rohlf FJ 1981: *Biometry*. W.H. Freeman, New York.
Zar JH 1984: *Biostatistical analysis*. Prentice Hall, New Jersey.
Dalgaard, P. *Introductory statistics with R*. Springer.

TBBE0625 INTRODUCTION TO BIOMETRY PRACTICALS

Practicals:2
Credit: 2
Examination: written
Lecturer: Zoltán Barta associate professor

Aims. This practical is a complement to the course "An introduction to biometry". During this course we will explore the theoretical concepts presented in the theoretical part. You will also be presented and practice the practical workflow of data analyses using the **R** statistical environment. After the course you will be able to evaluate a small to medium volume research project.

Short description of the course. For the description of the topics covered, see the theoretical course description.

Literature

Sokal RR és Rohlf FJ 1981: *Biometry*. W.H. Freeman, New York.

Zar JH 1984: *Biostatistical analysis*. Prentice Hall, New Jersey.

Dalgaard, P. *Introductory statistics with R*. Springer.

TBBE0610 BIODIVERSITY

Lectures: 1+2
Credits: 3
Examination: written
Lecturer: Béla Tóthmérész, professor

Aim of the course: Conservation of bioiversity is the central topics of many scientific discipline.

Short description of course. The role of diversity in natural sciences, the importance in environmental conservation and management. Definition of biodiversity. Basic methods of measuring and characterizing biodiversity. Intrapolation and extrapolation of the number of species. Basic patterns of diversity and species distributions. Historical dynamics of the number of species. Species richness of the biosphere. Biodiversity gradient. Species-area relationships. The value of biodiversity, direct and indirect aspects. Conservation and management of biodiversity.

Literature

Magurran, A E. 1996. Ecological Diversity and Its Measurement (2nd edn.). Chapman & Hall, UK.
Rosenzweig, M. L. 1995: Species Diversity in Space and Time. Cambridge University Press, Cambridge, UK.

TBBE0626 METHODS OF ECOLOGICAL EXAMINATION

Lectures: 1
Credit: 1
Examination: written
*Examine*r: Marianne Szabó lecturer

The aim of the course is to provide students a basic knowledge in investigation of physical, chemical and biological features of water as well as physical, chemical and biological features of the terrestrial environment (air, soil, biological systems: plant, animal, microbes).
Topics of lectures: Methods of sampling. Planning of ecological projects, setting up and testing hypotheses. Experimental arrangements, statistical methods to estimate results. Assignement of sampling sites, establishment of size of samples and mathematical testing. Simultaneous application of physical, chemical and ecological processes, differences among methods. Explanation of complex data resulted in ecological methods. Major methodological processes. Investigation of organic and inorganic pollutants. Biological indication of environmental load. Presentation of data and issues of representative features. Writing reports and papers. Integrated analysis of ecological systems.
Literature:
Robert Leo Smith. 1996: Ecology and field biology. HarlerCollins College Publishers. 733pp.
Roger N. Reeve. 1994: Environmental analysis. ACOL (University of Greenwich), John Wiley and sons. 263pp.
Wetzel, R. G. and Likens, G. E. 1995: Limnological analyses. Spinger-Verlag. 390pp.

TBBE0626 METHODS OF ECOLOGICAL EXAMINATION PRACTICALS

Practicals: 3
Credits: 2
Examination: written
Lecturer: Marianne Szabó lecturer

The practical lessons involve:
Planning of investigations. Preparation of samples, evaluation of experimental data, writing reports and reading literatures. Sampling methods of biological products. implementation of main methods in practice. Complex examination of water, sediments and organisms. Modelling of the effects of pollutants on the environment. During the practicals students are going to work out a sampling method for the actual task, survey the literature of possible methods and evaluate the results in comparison with data of scientific literature.
Literature:
Robert Leo Smith. 1996: Ecology and field biology. HarlerCollins College Publishers. 733pp.
Roger N. Reeve. 1994: Environmental analysis. ACOL (University of Greenwich), John Wiley and sons. 263pp.
Wetzel, R. G. and Likens, G. E. 1995: Limnological analyses. Spinger-Verlag. 390pp.

TBBE0630: ECOLOGY OF TERRESTRIAL TAXA

Lectures: 1
Credits: 1
Practicals: 3
Credit: 2
Prerequisite: TBBE0102
Lecturer: Albert Tóth lecturer
Requirement: midterm + endterm practical exam, oral/ written

Aims: The subject is intended to introduce the characteristic /ecologically important taxa and functional groups of terrestrial ecosystems. Also, to provide expertise in identification of types, forms and species for practical tasks.

Short description of the course:

Characterization and classification of the edaphic fauna. Saprophagous, necrophagous and coprophagous assemblages. Soil dwelling phytophagous, predatory and parasitic taxa. Species assemblages of grasslands, phytophagous, flower-visiting and predatory taxa and their adaptations. Decomposition of wood debris. Vegetation of habitats under strong anthropogenic influence: tree plantations, agro-ecosystems, human settlements, mine waste heaps and tailing dumps, open excavated minesites, dig holes, railway embankments. Invasive exotic plants. Indicator plants (soil: water supply from well-drained to waterlogged, pH, nitrogen, mineral salts, heavy metals; air contaminants: SO_2, ozone).

TBBE0631: ECOLOGY OF AQUATIC TAXA

Classes per wk: 1+2+0 (lectures+tutorials and practicals)
Credits: 1+1+0
Prerequisite: TBBE0630
Responsible subject teacher: Albert Tóth, PhD
Instructors: István Grigorszky, senior lecturer; Sándor Alex Nagy, associate professor
Requirement: midterm + endterm practical exam, oral/ written

Aims: The subject is intended to introduce the characteristic /ecologically important taxa of transitional (semi-aquatic) and aquatic ecosystems. Also, to provide expertise in identification of types, forms and species for practical tasks.

Short description of the course. Classification of aquatic and wetland habitats. Ecologically important groups of the aquatic biota, their identification problems, sampling (collection) and identification (keys, field guides) methodology.

Literature:

Eisenbeis, G., Wichard, W 1985: Atlas zur Biologie der Bodenarthropoden. Gustav Fischer Verlag, Stuttgart – New York, 434 pp.
Fitter, R., Manuel, R. 1986: Collins Field Guide to Freshwater Life. William Collins, Sons & Co., Ltd, London, 382 pp.
CORINE Biotopes Manual – Habitats, Chapter 0–9, http://biodiversity-chm.eea.europa.eu /information/document/F1088156525/F1125582140

TBBE0635 HYDROBIOLOGY

Lectures:2
*Credit:*3
Examination: written
Lecturer: Alex Sándor Nagy associate professor

Aims: The course includes basic information on hydrosphere as a medium and environmental component, with special respect to water body types and their living world.
Short description: The water (hydrologic) cycle. Hydrosphere as a medium and environmental component (main morphological, physical and chemical characteristics). Cycles of important biogenic elements (C, O, N, S, P and some microelements). Classification of water bodies. Distinctive assemblages of the chief water body types. Water bodies as biotopes: life zones and life form types. Main structural/anatomical and functional types, physiological characteristics of the aquatic organisms, their adaptations to the physical and chemical features of the medium and solid substrate. Main components of aquatic ecosystem metabolism: matter cycle and energy flow. Classification of aquatic organisms according to their roles in aquatic ecosystem metabolism: types and characterization. Concept and main forms of aquatic biological production (food chains and food webs). Nutrient budget and eutrophication. Water quality and water pollution. Principles of water use, conservation and management. The role and significance of aquatic organisms in natural and artificial systems and in environmental management.
Literature
Wetzel, R.G. 1975: Limnology. – W.B. Saunders Company, Philadelphia – London – Toronto, XI + 743 pp.

TBBE0652 CONSERVATION GENETICS

Lectures: 2
Credits: 2
Examination: oral and written
Lecturer: Katalin Pecsenye associate professor

Aims of the course: To get an overview on the different levels of genetic variation and to learn the most important evolutionary forces influencing the genetic structure of small populations.
Subjects of the course*:* The significance of genetic diversity. Different levels of genetic varaition: variation in morphometric traits, chromosomal polymorphism, enzyme polymorphism, variabiliy at the DNA level. Various ways of studying DNA polymorphism: RFLP, RAPD, mini- and microstellites.
Inbreeding: inbreeding coefficient, correlation between inbreeding and population size, inbreeding depression. Genetic drift. The consequences of genetic drift: random walk, loss of genetic diversity. Bottleneck effect and founder effect. Adaptive variation. Level of heterozygosity and fitness. Selection in small populations. Genetic differentiation: background, significance and consequences. Possibilities to measure genetic differentiation: genetic distances, fixation index, Wright's F-statistics. Distance matrix and different kind of dendrograms. Gene flow, migration models and introgression. Genetic processes in fragmented habitas, metapopulation structure, the significance of ecological carridors.
Literature:
Frankham, R., Ballou, J.D. and Briscoe, D.A. 2004. A primer of conservation genetics. Cambridge University Press
Beebee, T. and Rowe, G. 2004. An introduction to molecular ecology. Oxford University Press
Avise, J.C. 1994. Molecular markers, natural history and evolution. Chapman and Hall

TBBE0654 PHYLOGENETICS AND PHYLOGEOGRAPHY

Lectures: 2
*Credit:*2
Examination: written and oral
Lecturers: Zoltán S. Varga professor and Szabolcs Lengyel lecturer

Scope of the lectures: A review of the major trends and steps of the biological evolution. Principles and methods of the phylogenetics and phylogenetic systematics. Principles and methods of the phylogenetic biogeography and molecular phylogeography.
Description of the courses: Major trends and steps of the biological evolution: mega- and macro-taxonomy of biota. Molecular organisation and evolution of Archaea and Bacteria. Origins of the eukaryotic organisation and of the sex. Life cycles in eukaryotic Protista. The origins and major trends of multicellularity and organisation („Bauplan") with special respect on *Animalia.* Genome evolution in Animalia: duplications and modular organisation, evolution of „Hox"-genes in connection with the evolution of segmantation.
Principles of evolutionary and phylogenetic systematics: basic concepts. Biological species as concept, category and taxon. Phylogenetic analysis of character states: plesiomorphy and apomorphy, synapomorphy and homoplasy. Concepts of monophyly, poliphyly and paraphyly. Principle of Maximum Parsimony. Data matrices and construction of phylogenetic trees. Principles and methods of phylogenetic biogeography, constructions of area-dendrograms and –cladograms. The combination of molecular phylogenetic and biogeographic methods: molecular biogeography and phylogeography. Phylogeographic case studies: speciation, paleo-ecology and area-evolution during the Quaternary period.
Literature:
Wiley, E. O. 1981. *Phylogenetics: Theory and Practice of Phylogenetic Systematics*, - Wiley and Sons, New York
Hewitt, G.M. (2000) *The genetic legacy of the Quaternary ice ages.* - *Nature* **405**: 907-913.
Avise, J.C. *and* Hamrick, J.L. (1996): *Conservation Genetics: Case Histories from Nature*. - Chapman and Hall, New York - London, pp. 512.
Avise, J. C. (1999): *Phylogeography: The History and Formation of Species***,** - Harward U. P., Cambridge, M.,.

MODULE V. COMPULSORY SUBJECTS OF DIFFERENTIATING MATERIAL

Block I. VITICULTURE

TBBE0420 MICROBIOLOGY OF WINE AND WINE MAKING
Lectures: 3
*Credit:*4
Examination: written
Lecturer: Zsolt Szilágyi senior lecturer

Aims and short description of the course: Major types of microorganisms of grape, fermenting grape-juice (must) and wine. Lactic acid bacteria and acetic acid bacteria. Malolactic fermentation. Alcoholic fermentation. Types of yeasts. Filamentous fungi on grape and their importance in wine making. Botrytis and botrytisation (noble rot). Composition of natural microflora. Genetics of yeasts and filamentous fungi. Parasexuality of fungi. Incompatibility. Methods of genetic analysis. Chromosome length polymorphism and its role in the determination of fermentation abilities. Genetic transformation. Cloning.

Vectors. Directed mutagenesis. Application of genetic modification to strain improvement and starter development.

Literature:

Fugelsang, K.C.: Wine Microbiology. Chapman and Hall, New York, 1997.
Fleet, G.H.: Wine Microbiology and Biotechnology. Harwood Academic Publishers, Chur, 1993
Ciani, M.: Biodiversity and Biotechnology of Wine Yeasts. Research Signpost. Kerala, 2002.

TBBE0425 WINE BIOTECHNOLOGY

Lectures: 2
Credits: 3
Examination: written
Lecturer: Matthias Sipiczki professor

Aims and short description of the course: Classification of wines. Methods of grape processing and prefermentation practices. Spontaneous and directed fermentation. In-barrel fermentation. Fermentation in tanks and fermentors. Population kinetics of fermenting microorganisms. Starter cultures and their use in directed fermentation. Methods starter production: selection, hybridisation and genetic engineering. Aging. Microorganisms affecting aging. Protecting the wine. Microbial spoilage. Interactions between microorganisms. Antagonism and killers. Microbiology and fermentation of specific wines. Botrytised wines.

Literature: departmental handouts

TBBL0425 WINE BIOTECHNOLOGY PRACTICALS

Practicals:2
*Credit:*1
Examination: written
Lecturer:Matthias Sipiczki professor

Short description: Microscopic examination of wine microorganisms. Bacteria, yeasts and filamentous fungi. Detection and culturing of wine microorganisms. Pure cultures. Single-spore cultures. Methods of taxonomic identification. Ribotyping. Detection of killer yeasts. Methods of yeast hybridisation. Laboratory-scale fermentation. Site visits in wineries.

Literature:

Fleet, G.H.: Wine Microbiology and Biotechnology. Harwood Academic Publishers, Chur, 1993.
Jackson R.S.: Wine Science. Principles, Practice, Perception. Academic Press, San Diego, 2000.

Block II. FOOD INDUSTRY

TBBE0520 BASICS OF FOOD QUALITY MANAGEMENT

Lecture: 1
Credit: 1
Examination: written
Lecturer: Zoltán Győri professor

Aim of the course: The fields of food quality management and food safety have evolved substantially over the past decade, and certain key developments have become widely accepted. These include Quality Systems (e.g., ISO 22000) and HACCP. Consequently, it has become essential for students preparing for careers in the food industry to have some basic and applied training in these systems, their regulations and their practical application.
Short description of course: Food safety and quality. Food laws and regulations – and their enforcements. Food standards. ISO 22000:2005 Food safety management systems. Food quality and safety – systems, programs, regulations, hazards and practices. Good Manifacturing Practices (GMP) and HACCP programs.
Literature
Ewans, J.R., Lindsay, W.M. (1993). The management and quality of control. Second edition. West Publishing Company, Minneapolis, St. Paul
Alli, I. (2003). Food Quality Assurance: Principles and Practices. CRC Press
Hagstad, H.V., Hubbert, W.T. (1986). Food Quality Control. Iowa State University Press / Ames
Hosotani, K. (1992). Japanese quality concepts. Qiality Resources, New York

TBBE0521 FOOD MICROBIOLOGY AND BIOTECHNOLOGY I.
Lectures:2
*Credit:*3
Examination: written
Lecturer: Tünde Pusztahelyi lecturer
Prerequisites: TBBE0511

Aim: Students become familiar with a branch of industrial microbiology related and food microbiology. Through the course of lectures students gain knowledge in the basics of food safety, food microbiology and hygiene and microbiology of basic food products.
Short description of lectures*:* Students are acquainted with the useful and damaging micro-organisms traceable in foodstuff as well as environmental factors that influens the status of foodstuff. The course of lectures covers food poisoning caused by micro-organisms and introduction of microbiological processes of putrefaction, includes discussion of basics of storage and preservation processes as well as provides introduction into standardized examination of food for microbiological certification.
Literature:
Doyle, M., Beuchat, L., Montville, T.J. Eds.: Food Microbiology: Fundamentals and Frontiers. ASM Press, Washington, DC, 2001
Jay, J.M., Loessner, M.J., Golden, D.A.: Modern Food Microbiology, Springer, 2005

TBBL0521 FOOD MICROBIOLOGY AND BIOTECHNOLOGY PRACTICALS
Practicals: 3
*Credit:*2
Examination: written
Lecturer: Tünde Pusztahelyi lecturer

Short description: Methods for classical microbiological culturing. Standard culture media. Specific methods for sample preparation of different food types. Decimal dilution. Determination of microbial number. Microbial count types: plate technique, determination of the titre and the most probable number. Determination of the number of yeast and molds from cereals and their products. Classical methods for identification of micro-organisms that important in respect of food hygiene (*Enterobacteriaceae*, *E. coli, Clostridium*,

psychrophile micro-organisms, *Salmonella, Bacillus cereus*) and the indicator flora. Investigation of thermal death of spore forming and non-spore forming bacteria. Microbiological examination of spring water and tap water. *Pseudomonas aeruginosa.* Fermented food. Determination of the number of mesophile lactate producing bacteria. Comparison of dried and wet baker yeast viability. Solid phase fermentation.

Literature:

Lengeler, J.L., Drews, G., Schlegel, H.G.: Biology of the Prokaryotes, Georg Thieme Verlag, Stuttgart, 1999

TBBE0522 FOOD MICROBIOLOGY AND BIOTECHNOLOGY II.

Lectures:2
*Credit:*3
Examination: written
Lecturer: Tünde Pusztahelyi lecturer
*Prerequisite*s: TBBE0520, TBBE0521

Aims: Through the course students became acquainted with the basics of production technology of foods and additives by regulated microbial activity, the possibilities of genetic modification and strain improvements, and regulated application of microbes in waste utilisation.

Brief description of lectures*:* The lectures review the technology of fermented milk and meat industrial products, their microbiology and biotechnology, the starter cultures, the traditionally fermented foods and drinks as well as the process of acetic acid production. They give insight into the production of additives of microbial origin and the possibilities of waste utilization by microbes (SCP). Students are introduced to the propagation of algae, fungi, and bacteria for human consumption and feed and the lectures discuss the possibilities of agricultural utilisation of fungi and its biotechnological background..

Literature:

Doyle, M., Beuchat, L., Montville, T.J. Eds.: Food Microbiology: Fundamentals and Frontiers. ASM Press, Washington, DC, 2001
Jay, J.M., Loessner, M.J., Golden, D.A.: Modern Food Microbiology, Springer, 2005

Block III. FERMENTATION

TBBG0550 FACTORY VISITS

Practicals:2
*Credit:*1
Examination: oral
Lecturer: Levente Karaffa senior lecturer
Prerequisites: TBBE0425/ TBBE0520/TTBE50t

Aim of the course: Chemical, pharmaceutical and fermentation companies of regional or national importance will be visited upon to gain an insight into some of the production processes that occur there. In addition, the course wishes to facilitate communication between our senior students looking for a job and the companies seeking suitable applicants.

Description of the course*:* The course will be made available in each semester, thus our students should have the opportunity to visit and look around in some of the major regional and national plants of the chemical, pharmaceutical, fermentation, food-processing and dairy industry. The following companies host our students regularly: TEVA-Pharmaceutical Co. (Debrecen), Agroferm Co. (Kaba), Borsod Brewery Co. (Bőcs), Minna Dairy Co. (Miskolc), Tokaj Trading House Ltd. (Tokaj), Research Institute for Viticulture and Enology (Eger), Richter Gedeon Pharmaceutical Works Co. (Budapest-Kőbánya), Budafok Yeast Factory (Budapest-Budafok), Dréher Brewery (Budapest-Kőbánya), Nestlé Hungary Kft. (Miskolc-Diósgyőr).

Literature:

Stanbury, P.F. and Whitaker, A.: Principles of Fermentation Technology. Pergamon Press, Oxford, UK.

McNeil, B., Harvey, L.M.: Fermentation: a Practical Approach. IRL Press, Oxford, UK.

Pirt, S.J.: Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford, UK.

Wang, D.I.C., Cooney, C.L., Demain, A.L., Dunnill, P., Humphrey, A.E., Lilly, M.D.: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.

TTBE50r PROCESSES AND UNIT OPERATIONS IN BIOENGENEERING

PART I

Lectures:2
*Credit:*3
Examination: oral
Lecturer: Levente Karaffa senior lecturer
Prerequisites: TBBE0511

Aim of the course*:* We wish to provide an insight into the biological and technological basics of bioengineering by teaching the major and most substantial processes and operations as well as the qualitative and quantitative nature of interactions between them.

Description of the course: Economic significance of biotechnology, major products, production statistics and trends. Microbial (viral, procaryotic, yeast and fungal) growth kinetics – parameters of growth and analysis of growth data. The isolation, preservation and improvement of industrial microorganisms. Microbial stochiometry. Media for industrial fermentations. The development of inocula for industrial fermentations. Batch, fed-batch and continuous flow cultures. Multistage systems, feedback systems. The application of continuos culture in industrial processes, strain isolation and improvement. Application of fed-batch culture. Design of a fermenter. Agitation and aeration. Fluid rheology. Foaming and its control. The packed tower, the Waldhof-type, the cyclone column, the air-lift, deep-jet and rotating disc fermenter. Acetators and cavitators. Sterilization of fermenters and vessels, liquid media and gases. Aseptic operation and containment.

Literature:

Stanbury, P.F. and Whitaker, A.: Principles of Fermentation Technology. Pergamon Press, Oxford, UK.

McNeil, B., Harvey, L.M.: Fermentation: a Practical Approach. IRL Press, Oxford, UK.
Pirt, S.J.: Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford, UK.
Wang, D.I.C., Cooney, C.L., Demain, A.L., Dunnill, P., Humphrey, A.E., Lilly, M.D.: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.

TTBE50t PROCESSES AND UNIT OPERATIONS IN BIOENGENEERING, PART II

Lectures:2
*Credit:*3
Examination: oral
Lecturer: Levente Karaffa senior lecturer
Prerequisites: TTBE50r

Aim of the course*:* To provide additional basic knowledge in bioengineering science not discussed in Part I. In addition, via a compact lab course attached to this lecture set, we want to ensure that our student understand the most crucial and widespread techniques of bioengineering in practical terms, too.
Description of the course: Fermenter instrumentation and control. Sensors. Control systems – manual and automatic control. On-line analysis. Cell morphology and its impact on product formation. The recovery and purification of fermentation products. Filtration, centrifugation, cell disruption, liquid-liquid extraction, solvent recovery, chromatography, crystallization, whole-broth processing. Effluent treatment – physical, chemical and biological treatment. Aerobic and anaerobic treatment. Fermentation economics: producing costs, market potential. Processes and operations using enzymes. Enzyme isolation. Classification of enzymes of industrial importance. Kinetics of enzymes. Enzyme reactions in homogenous and heterogenous phase. Principles of enzyme and whole-cell based bioconversions. Enzyme immobilization.
Literature:
Stanbury, P.F. and Whitaker, A.: Principles of Fermentation Technology. Pergamon Press, Oxford, UK.
McNeil, B., Harvey, L.M.: Fermentation: a Practical Approach. IRL Press, Oxford, UK.
Pirt, S.J.: Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford, UK.
Wang, D.I.C., Cooney, C.L., Demain, A.L., Dunnill, P., Humphrey, A.E., Lilly, M.D.: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.

TTBL50t PROCESSES AND UNIT OPERATIONS IN BIOENGINEERING PRACTICALS

Practicals:3
*Credit:*2
Examination: oral
Lecturer: Levente Karaffa senior lecturer
Prerequisites: TTBE50r

Description of the practical course*:* Laboratory-scale (10 L), submerged, batch fermentation of a filamentous fungus will be monitored and analysed. Time-profiles of carbon source consumption, oxygen uptake rate, biomass, carbon dioxid and product formation rate are determined by standard bioanalytical equipments (HPLC, GC, ion-exchange chromatography). Demonstration of certain downstream processing techniques

such as adsorption evaporation, filtration and dialysis. Qualitative and quantitative analysis of alcohol production by yeast.

Literature:

Stanbury PF and Whitaker A: Principles of Fermentation Technology. Pergamon Press, Oxford, UK.
McNeil B, Harvey LM: Fermentation: a Practical Approach. IRL Press, Oxford, UK.
Pirt, SJ: Principles of Microbe and Cell Cultivation. Blackwell Scientific Publications, Oxford, UK.
Wang DIC, Cooney CL, Demain AL, Dunnill P, Humphrey AE, Lilly MD: Fermentation and Enzyme Technology. John Wiley & Sons, New York, U.S.A.

TBBE0525 MICROBIAL PHYSIOLOGY

Lectures:2
*Credit:*3
Examination: oral
Lecturer: Attila Szentirmai professor
Prerequisites: TBBE0506

Aim of the course*:* We will analysise the relationship between the microbial world and its environment, and will focus on the crucial role the microorganisms play in the establishment and maintenance of life on Earth.

Description of the course*:* Physiological mechanisms for the generation of energy in the presence of hydrogen, light, sulphur, carbon, etc. Detailed analysis of the interactions a procaryotic and an eucaryotic cell respectively exhibits over its environment. Substrate transport, export of metabolic by-products. Mechanisms of transport and the means these mechanisms are sustained. Comparative analysis of the physiology of anaerobic Archeabacteria and aerobic Eubacteria. Carbon cycle in nature, with an emphasis on the performance of the microbial world. Carbon dioxide and methane uptake and consumption. Oxidation and reduction of carbon during the generation of energy. Oxidative phosphorylation and its relationship to other major physiological mechanisms. Physiological role of sterins and lipids. Nitrogen cycle and metabolism.

Literature:

Dawes, I.W., Sutherland, I.W.: Microbial physiology. Blackwell Publishing, New York, U.S.A.
Rhodes, P.M., Stanbury, P.F.: Applied Microbial Physiology - A Practical Approach. Oxford University Press, Oxford, UK.

TBBL0525 MICROBIAL PHYSIOLOGY PRACTICALS

Practicals:2
*Credit:*1
Examination: oral
Lecturer: Attila Szentirmai professor
Prerequisites: TBBE0506

Aim of the practical course*:* Application of the knowledge acquired in the lecture course, based on the methodological know-how previously obtained in the Microbiology and Mycology practical courses.

Description of the practical course: Investigation of the mitochondrial respiration. Isolation and preparation of intact mitochondria from yeast cells. Analysis of respiration by

Clark-type oxygraphic cell. Manipulation of the oxidative phosphorylation by ADP and uncoupler agents. Formation and elimination of mitochondria in yeasts. Protease and amylase formation in *Bacillus subtilis* cultures. Carbon catabolite repression by glucose. Carbon derepression in *Escherichia coli*. Glutaminic acid dehydrogenase activity assay from crude extract of *Penicillium chrysogenum* in the exponential and stationary phase of growth and following glucose supplementation.

Literature:

Dawes, I.W., Sutherland, I.W.: Microbial physiology. Blackwell Publishing, New York, U.S.A.

Rhodes, P.M., Stanbury, P.F.: Applied Microbial Physiology - A Practical Approach. Oxford University Press, Oxford, UK.

Block IV. UTILIZATION OF WASTE PRODUCTS

ENVIRONMENTAL TECHNOLOGY

Lectures: 1
Credit:1
Examination: written and oral
Lecturer: Jenő Borda associate professor and János Török assistant professor

Aim of the course: The aim of the lecture is to provide students a basic knowledge on the production processes on the environment and to introduce them the modern waste management.

Short description of course. Lectures: Environmental effect of the production processes. Waste reduced technologies. Species and characterization of wastes. Dangerous wastes. Principles and solutions of modern waste management. Gas (vapour), liquid and solid industrial wastes and operational techniques for their handling. The additional protection of environment, the integrated protection of environment to the production processes and product. Communal wastes and possibilities for their handling. Burning, storing and utilizing of wastes.

Literature

1. Ann Boyce, A.: Introduction to Environmental Technology (John Wiley & Sons Inc 1997)
2. Burke, G., Ramnarine Singh, B, Theodore, L.: Handbook of Environmental Management and Technology (John Wiley & Sons Inc 2000)

SEMINARS ON ENVIRONMENTAL TECHNOLOGY

Practicals: 3
Credits:2
Examination: oral
Lecturer: Jenő Borda associate professor and János Török assistant professor

Short description of seminars

On the seminar serves to discuss some techniques and preventative means to protect the environment. Workshop will be held on the most important industrial handlings and preventions of wastes. Students choose topics about prevention and handling of wastes and give short lectures followed by discussion. All students have to give a short lecture about a given topic based on the references they were studying. Thus lecture will be part of the oral examination.

Literature

1. Ann Boyce, A.: Introduction to Environmental Technology (John Wiley & Sons Inc 1997)
2. Burke, G., Ramnarine Singh, B, Theodore, L.: Handbook of Environmental Management and Technology (John Wiley & Sons Inc 2000)

ENVIRONMENTAL PROTECTION BIOTECHNOLOGY

*Lectures***:** 1+2
*Examination***:** written
Credits: 2
Lecturer: Marianne Szabó lecturer

The aim of the course is to give students a basic knowledge in biotechnological processes of environmental protection, in planning of researches and methods of examinations as well as in application of these methods in practice.
Topics of lectures: Environment and environmental protection; Natural environment (natural resources), man-made environment, social environment and the environmental-ecological crisis; Treatment of wastes (primary, secondary and tertiary treatment, disposal), wastewater treatment, activated sludge, anaerobic wastewater treatment, micro algae, microbiological mining, bioremediation. Phytoremediation, phytoextraction, phytofortification. Characteristics of wetlands, constructed wetlands, petrochemical wastewaters. Conceptions of reactor technology, biogas, bio diesel, compost. ETS (Electron Transport System)-test.
Literature:

Hickey, R. F. and Smith, G. 1996: Biotechnology in industrial waste treatment and bioremediation. Library of Congress Cataloging-in- publication Data. USA, 379 pp.
Grainger, J. M. 1984: Microbiological methods for environmental biotechnology. Academic Press INC. London, 421pp.

TBBE0645 TOXICOLOGY AND ECOTOXICOLOGY

Lectures: 1+2
Credit: 3
Examination: written
Lecturer: Varga Zsuzsa associate professor, Lakatos Gyula associate professor,

Aims of the course: This course aims to discuss toxicological and ecotoxicological issues from scientific and socio-economic viewpoint, so the students are understood not only as a science (or inter-discipline) but also as social problems and issues.
Short description of course: Terminological system of toxicology and ecotoxicology. Clinical and human toxicology. Toxicological tests. Genotoxicity, indirect genotoxicity mechanisms. Citotoxicity, mitogenesis and genotoxicity in carcinogen risk assessments. The role of multidrog transporters in drug availability, metabolism and toxicity. Neurotoxicity. Assessment of the allergenic potential of proteins. Immunoassays.
Human toxicology. Assessment of risk to humans. Interpreting toxicity data. Human exposure to environmental chemicals. Fate and behaviour of chemicals in the environment. The degradation of environmental contaminants.
Effects of pollutants on ecosystems. Environmental toxicity testing. The process of environmental risk assessment. Environmental monitoring. Ecotoxicity testing. Biochemical effects of pollutants. Physiological effects of pollutants. Biomarkers. Effects of pollutants and contaminants on populations and communities. Evolution of resistance to pollution. Ecotoxicology and management of chemicals.

References:

Burdon, R.H. 1999: *Genes and the environment.* Taylor and Francis Ltd., London.
Connell, D., Lam, P., Richardson, B., Wu, R. 1999: *Introduction to ecotoxicology.* Blackwell Science Ltd., Oxford.
Walker, C.H., Hopkin, S.P., Sibly, R.M., Peakall, D.B. 2003: *Principles of ecotoxicology.* Second edition. Taylor and Francis Ltd., London.

Block V. PLANT BIOLOGY

TBBE0120 PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY

Lectures: 3
*Credit:*4
Examination: written
Lecturer: György Borbély professor

Aims: The full time program requires students to successfully complete this course Plant biochemistry and molecular biology. Students will have a broad knowledge of the field of plant biology as well as demonstrate detailed knowledge and applied research skills in the area of plant biology. At the undergraduate level, students who complete research based projects will be well prepared for further graduate educations or for employment in academics or industry.

Short description of the course: Biochemistry of plant cells. Plant genome and gene expression of plants. Plant gene organization and plant metabolism. Molecular characterization of plant membranes, membrane potentials. Assimilation and transport: photosynthesis, water, and ion absorption, translocation. The global importance of photosynthetic electron transport. C2, C3, C4 CAM types of photosynthetic carbon fixation. Water uptake, transport and functioning of stomata. Nutrient uptake from the soil (nitrogen, sulfur, phosphorous etc.). Nitrogen fixation of cyanobacteria (DNA rearrangement) and *Rhizobium* species. Nitrate and nitrit reduction. Amino acid and protein synthesis. Characteristics of plant respiration (glycolysis, citrate cycle and terminal electron transport). Characteristics of plant respiration (glycolysis, citrate cycle and terminal electron transport). Growth, development and senescence of plants. Plant hormones (auxins, gibberellins, cytokinins, ethylene, abscisic acid, brassinosteroids, jasmonates etc.) and regulation gene expression. Tissue culture of plants. Cell cycle regulation. Plant genomics and proteomics. The importance of cell and tissue culture systems in transgenic plant production. *Agrobacterium* mediated T-DNA transfers and vector system responsible for gene transfer. Physiology and biochemistry of plant diseases. Plant responses to pathogens (viruses, bacteria, fungi), plant defense system.

Literature:

Taiz, L., Yeiger, E. (1998) Plant physiology. Sinauer Associates Inc., Publishers, Sunderland, Massachusetts.

TBBL0120 PLANT BIOCHEMISTRY AND MOLECULAR BIOLOGY PRACTICALS

Practicals: 2
Credit: 1
Examination: written and oral
Lecturer: George Borbely professor

Short description. Students choose experiences in hands-on laboratory techniques in aspects of modern plant approaches, including plant cell and molecular biology. Department's

research facilities advanced microscopy equipments, separation techniques etc. will support education and research. Isolation of plant organelles (chloroplasts, nuclei, mitochondria). Preparation of plant protoplast, regeneration of plant tissues, *Agrobacterium* mediated plant transformation. Preparation, purification and characterization plant macromolecules proteins, enzymes and nucleic acids (DNA and RNA, cellulose, polysaccharides, lignins - suberation) based on. Application of electrophoretic separation of macro molecules (DNA, RNA, Protein complexes etc.) of plant origin.

Literature:

Departmental hand-outs on Plant biochemistry and molecular biology

TBBE0125 PLANT BIOTECHNOLOGY

Lectures: 2
Credit points: 3
Examination: written
Lecturer: Gyula Surányi senior lecturer

Aims are to review the present research on using genetically **ENGINEERED PLANTS AND PLANT VIRUSES TO PRODUCE NEW PRODUCTS FOR INDUSTRY AND MEDICINE**

Subject areas: Features of the plant cell from the viewpoint of biotechnology. Basic methods in plant biotechnology. Plant regeneration. Callus cultures: organogenesis and somatic embryogenesis. Micropropagation and in vitro fertilization. Plant cell suspension cultures. Protoplasts: isolation, culture and fusions. The production of genetically modified plants: *direct DNA transfer* - electroporation, microinjection, the use of PEG, particle mediated transformations, gene guns; *indirect DNA transfer* - somaclonal variation and techniques for the creation of transgenic plants, somatic hybrids; transformation by microbes, *Agrobacterium* system; plant viral vectors. Detecting DNA variation by molecular markers. Gene activity in genetically modified plants. Stress tolerance and increased metabolic activity in transgenic plants. Expression of full-length proteins in engineered plants: antiviral, antimicrobial and antifungal proteins. Plant-based biopharmaceutical production. Antibody production in plants for human therapeutic use - transgenic plants as edible vaccines: oral immunogenecity and adjuvants; vaccines against viral (hepatitis B, Norwalk virus, rabies virus) and bacterial pathogens (cholera).

Literature:

Hammond, J., McGarvey, P., Yusibov, V. {Eds.}(2000): Plant Biotechnology - New Products and Applications - Springer-Verlag Berlin Heidelberg
Nguyen, H.T., Blum, A. (2004). Physiology and Biotechnology Integration for Plant Breeding – Taylor & Francis
D.T. Nhut, B.V. Le, K.T. T. Van and T. Thorpe {Eds.}(2003). Thin Cell Layer Culture System – Regeneration and Transformation Applications - Kluwer Academic Publishers, Netherlands
Razdan, M.K. (2003): Introduction to Plant Tissue Culture – Science Publishers, Inc., UK
Trigiano, R.N., Gray, D.J. (2004): Plant Development and Biotechnology – CRC Press
Weising, K., Nybom, H., Wolff, K., Kahl, G. (2005): DNA Fingerprinting in Plants – Principles, Methods and Applications – CRC Press

Block VI. BIOLOGY OF MEDICINAL PLANTS

TBBE0131 MEDICINAL PLANT PRODUCTS

Lectures: 2+0+1
Credits: 3
Examination: oral and written
Lecturer: Gábor Vasas senior lecturer

Aims: The subject intents to provide a summary of knowledge of the chemical compounds of medical plants and its utilizations.
Subject areas:
Biologically active compounds from marine organisms. General methods associated with the phytochemical investigation of herbal products. Production of crude drugs. Deterioration of stored drugs. An overview of drugs with tumor inhibitors, antiprotozoal, antihepatotoxic and oral hypoglycaemic activities. Saponins, cardio active drugs and other steroids. Coloring and flavoring agents. Miscellaneous product. Pharmacological activities of natural product.
Chemical agents of medical plants: laboratory course
Analytical methods associated with the phytochemical investigation of herbal products, investigation of traditional plant medicines
Literature:
Trease, G.E., Evans, W.C. (1983): Pharmacognosy, Elsevier, London
Trease, G.E., Evans, W.C. (2000): Pharmacognosy, Elsevier, London

TBBE0130 HISTOLOGY OF MEDICINAL PLANTS

Lectures:1
*Credit:*1
Examination: written
Lecturer: Márta Hamvas senior lecturer

Aims: The subject intends to provide a concise summary of present knowledge of the structure of vascular plants, with particular emphasis on medicinal plants.
Subject areas: Survey of plant dermal, ground (parenchyma, collenchyma, sclerenchyma, etc.) and vascular (phloem and xylem) tissue systems. Tissue and cell types of medicinal importance. Secretory tissues, secretory trichomes and glands developed in the epidermal and subepidermal tissues. Secretory structures occuring internally in the plant body (resin canals, mucilage ducts, laticifers, laticiferous system, etc.).Tissue differentiation in the young stem and root. Anatomy of the mature primary root, stem and rhizome. Dermal, ground and vascular tissues in leaves. Special tissues in the generative organs: in flowers, fruits and seeds. Secondary thickening of stem and root in dicotyledons and gymnosperms. Anatomy of the woody stem, elements and structures of secondary xylem and phloem, periderm and cork.
Literature:
Bowes, B.G. (1997): A colour Atlas of Plant Structure. Manson Publishing Ltd.
Trease, G.E., Evans, W.C. (1983): Pharmacognosy. Bailliere Tindall, London. (ISBN 0 70 1007 3).*pp*.1-63.

TBBL0130 HISTOLOGY OF MEDICINAL PLANTS PRACTICALS

Practicals: 2
*Credit:*1

Examination: written
Lecturer: Márta Hamvas senior lecturer

Short description: Preparation of transverse and longitudinal sections of the plant organs with curative effect. Microscopical investigation of the slides made from root, stem, leaf and flower drugs to recognize the most important histological features for drug identification.
Literature:
Bowes, B.G. (1997): A colour Atlas of Plant Structure. Manson Publishing Ltd.
Trease, G.E., Evans, W.C. (1983): Pharmacognosy. Bailliere Tindall, London. (ISBN 0 70 1007 3).*pp*.1-63.

TBBE0132 TOXIC AND MEDICINAL PLANTS

Lectures: 2
Credit: 3
Examination: written
Lecturer: Gábor Vasas senior lecturer

Aims: The subject intents to provide a summary of knowledge of the species of toxic and medical plants.
Subject areas: Description, morphology and anatomy of toxic and medical plants. Biological and geographical sources of drugs. Toxic and medical plants of *Thallophytes*, *Bryophytes* and *Pteridophytes*, *Gymnosperms*, *Angiosperms* (*Dicotyledons* and *Monocotyledons*), botanical and chemical characters of the more important orders and families of both non-flowering and flowering plants. The examination of powdered drugs and commercial fibres.
Literature:
Trease, G.E., Evans, W.C. (1983): Pharmacognosy, London (ISBN 070 1007 3)

Block VII. CELL AND TISSUE CULTURES

TBBE0230 CELL CULTURES AND CELLULAR PREPARATIONS

Lectures:2
*Credit:*3
Examination: oral
Lecturer: Gábor Nagy

Aims: to familiarize students with modern cell and tissue culture techniques and advanced methods of cell biology.
Short description of courses: Work area and equipments. Introduction to methodology for growing and maintaining tissues and cells. Types of cells grown in culture. Links to descriptions of specific cell lines, resource for suppliers. The National Cell and Tissue Culture Centre (NCTCC). *American Type Culture Collection (ATCC)*. Protocols related to Cell / Tissue Culture. Starting a new cell culture. Primary cell cultures. How to maintain cell cultures, preserve and store cells. Histotechniques. Fixation of tissues. Tissue sectioning. Staining techniques. Histochemistry. Molecular biology methods to study cells and tissues.
Literature
Paul, J.: Cell and tissue culture. Longman 5th edn. pp. 485. Spiral edition.
Doyle, A., Griffiths, J.B. Cell and tissue culture. 1993. John Wiley and Sons, 1993. ISBN:0471928526.
Masters, J.R. Animal Cell culture (Third edition) Oxford University Press, Oxford, 2000.

TBBL0230 CELL CULTURES AND CELLULAR PREPARATIONS PRACTICALS

Practicals:2
*Credit:*2
Examination: written
Lecturer: Gabor Nagy lecturer

Aims: The practicals will follow closely the thematics of the lectures and will introduce students to cell cultures and cell culture facilities. Each student will grow, maintain and store his/her cell culture.
Short description: Growing cells unattached to a surface referred to as suspension cultures. Growing adherent cultures cells tissue culture plastic (T) flasks. Cell and tissue culture maintenance/passaging, amplification of cell lines, transient transfection, generation of stably transfected cell lines.
Literature:
Vunjak-Novakovic G., Freshney R.I. (Eds). Culture of Cells for Tissue Engineering. [E-Book] This product is available for purchase from website: eu.wiley.com/WileyCDA/WileyTitle/productCd-0471741809.html
ISBN: 0-471-74180-9. 352 pages.

TBBE0530 TECHNIQUES OF IMAGE FORMATION

Lectures:2
Credit:3
Examination: written
Lecturer: Gabor Nagy lecturer

Aims: To study the organization of the living material classical microscopic methods and image formation methods are widespread. The aim of the course is that students should not only know these basic methods but also know how to combine them with their bioinformatical knowledge.
Short description: Introduction to optics. Composite image formation. Nuclear image formation methods. Light-sources. Methods of illumination. Fluorescence microscopy. Basics in electronmicroscopy. Three dimensional reproduction of microscopic structures. Introduction to bioinformatics. How to use biological data bases.
Literature:
Biotechnology Applications of Microinjection, Microscopic Imaging and Fluorescence.- Eds.: Bach et al.. Plenum Press, New York, 1993.

TBBL0530 TECHNIQUES OF IMAGE FORMATION PRACTICALS

Practicals:2
Credit:2
Examination: written
Lecturer: Gabor Nagy lecturer

Aims and short description: Types of radiations, potential sources of danger. Laser security. Stereomicroscopy. Installation of light microscopes. Light microscopic photography. Computer based determination of cell size. How to use eTox workstations. Fluorescent

microscopy. Three dimensional reproduction of fluorescent microscopic images of intermediates of chromatin condensation and analysis wth CIA 3.0 sftware. Real time *in vivo* imaging of Caenorhabditis elegans and image analysis by the DRIP system. Layer photography of using structured light. 3D analysis of photographed layers. Creating surface models. Stereoscopic anaglyph imaging. How to present your images.

Literature:

Biotechnology Applications of Microinjection, Microscopic Imaging and Fluorescence.- Eds.: Bach et al.. Plenum Press, New York, 1993.

GENERAL TAXONOMY

Lectures: 2
Credit point: 3
Examination: written
Lecturer: György Dévai professor

Aims of the course: The course includes basic information on theoretical and practical aspects of taxonomy, as the science of organic diversity.

Major topics of the course: Differential principle in the science: basic reference system. Systematics and taxonomy. Taxonomy as the science of organic diversity. The history and the future of taxonomy. Strategies in taxonomic research. Micro- and macrotaxonomy. Phenon, taxon, category. Individual and population. Population structure. Intrapopulational (nongenetic and genetic) variation. Adaptation and selection. Isolating mechanisms. The species concept and the speciation. Infraspecific categories and terms. Polytypic species. Supraspecific categories and terms. Diversity in life's kingdoms. Theory and practice of biological classification. Taxonomic characters. Cladistics. Classification and phylogeny. Evolution and evolutionary classification. The general and specific rules of nomenclature. Taxonomic collections and the process of identification. Kinds, major features, form and style of taxonomic publications.

Literature:

Mayr, E. – Ashlock, P.D. 1991: Principles of systematic zoology. 2nd edit. – McGraw-Hill, Inc., New York, XX + 475 pp.

ENVIRONMENTAL QUALIFICATION AND STATE ASSESSMENT

Lectures: 2
Credit point: 3
Examination: written
Lecturer: István Grigorszky senior lecturer

Aims: The course includes basic information on synbiological indication, with special respect to nature conservation and environmental protection.

Short description of the course: Conceptual and technical aspects of nature conservation and environmental protection, with reference to their relationship. The principle of multiplural environment. Quality and goodness. Geosphere, biosphere and noosphere as environmental components. Character and status of environmental components. The panbiota and its components. Supraindividual organization, a unified concept for the interpretation of synbiological phenomena. Subdisciplines of synbiology. Encaptic system of the biota and its surroundings. The comprehensive description of synbiological indication. Concept of structure and the levels of its characterization. Concept of function, and the necessarily related nature of structure and function. Concepts of landscape and landscape type, representative

examples in Hungary. Ecological foundations of land use, conservation and management. Natural and environmental state and impact assessment studies. Environmental status of Hungary. Natural and human processes and activities affecting the structural and functional harmony of the planet (Gaia-hypothesis). Principles of sustainable development. Aspects and ecological basis of economy. World models. Development and importance of an environment-conscious way of thought.

Literature

Chiras, D.D. 1991: Environmental science. Action for a sustainable future. 3rd edit. – The Benjamin/Cummings Publishing Company, Inc., Redwood City, California, XXI + 549 pp.