BULLETIN

UNIVERSITY OF DEBRECEN

ACADEMIC YEAR 2017/2018

MSc in Molecular Biology

FACULTY OF MEDICINE

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CHAPTER 1
INTRODUCTION

The aim of the University of Debrecen is to become a university of medical sciences committed to the prevention and restoration of health of the people, not only in its region but in the entire country.

In the past two decades both medical science and health care have entered a new era: the medical science of the 21st century. Molecular medicine is opening up and new possibilities are available for the diagnosis, prevention, prediction and treatment of the diseases. One can witness such a progress in medical sciences that has never been seen before. Modern attitudes in health care should be enforced in practice, including therapeutical approaches that consider the explanation and possible prevention of diseases, and attempt to comprehend and take the human personality into consideration. These approaches demand the application of the most modern techniques in all fields of the medical education.

All curricula wish to meet the challenges of modern times and they embody some very basic values. They are comprehensive; they take into consideration the whole human personality (body and soul) in its natural and social surroundings; and they are based upon the best European humanistic traditions. Moreover, all curricula prepare students for co-operation and teamwork.

With respect to education, both students and teachers are inspired to acquire higher levels of professionalism, precision, and problem solving skills, upon which the foundations of specialist training and independent medical practice can be built. This approach enables the assimilation of new scientific developments, facilitating further education and the continuous expansion of knowledge. The interplay of these factors ensures the ability to understand and handle the changing demands of health care.

With respect to research, the faculty members continuously acquire, internalize and subsume new knowledge, especially concerning the genesis, possible prevention and treatment of diseases. Moreover, new information aimed at improving, preserving and restoring the health of the society is also absorbed. The University of Debrecen is already internationally recognized in the fields of both basic and clinical research, and the clinicians and scientists of the University are determined to preserve this achievement. Special attention is given to facilitate and support the close co-operation of researchers representing basic science and clinical research, and/or interdisciplinary studies.

With respect to therapeutic practice, the main objective is to provide high quality, effective, up to date and much devoted health care to all members of the society, showing an example for other medical institutions in Hungary. One of the primary tasks is to continuously improve the actual standards of the diagnostic and therapeutic procedures and techniques, and to establish regional or even nationwide protocols.

With respect to serving the community, all faculty members wish to play a central role in shaping the policies of the health service; both within the region and in Hungary. They also want to ensure that sufficient number of medical doctors, dentists and other health care experts with university education is provided for the society.

With respect to the development, all employees strive for reinforcing those features and skills of the lecturers, scientists, medical doctors, health care professionals, collaborators and students which are of vital importance in meeting the challenges of medical education, research and therapy of the 21st century. These include humanity, empathy, social sensitivity, team-spirit, creativity, professionalism, independence, critical and innovative thinking, co-operation and management.

The organizational structure, including the multi-faculty construction of the institution, is a constantly improving, colorful educational environment, in which co-operation is manifest between the individual faculties and colleges, the various postgraduate programs as well as the molecular-

and medical biology educations.

HIGHER EDUCATION IN DEBRECEN
A Brief History
1235: First reference to the town of Debrecen in ancient charters.
1538: Establishment of the “College of Reformed Church” in Debrecen.
1567: Higher education begins in the College.
1693: Declaration of Debrecen as a “free royal town”.
1849: Debrecen serves as the capital of Hungary for 4 months.
1912: Establishment of the State University of Debrecen comprising the Faculties of Arts, Law, Medicine and Theology.
1918: Inauguration of the Main Building of the Medical Faculty by King Charles IV of Hungary.
1921: The Medical Faculty becomes operational.
1932: Completion of buildings of the campus.
1944: Although during the Second World War, Debrecen became the capital of Hungary again (for 100 days), the University itself is abandoned for a while.
1949: The only year when the University has five faculties.
1950: The Faculty of Law idles; the Faculty of Science is established.
1951: The University is split up into three independent organizations: Academy of Theology, Medical School, Lajos Kossuth University of Arts and Sciences.
1991: The “Debrecen Universitas Association” is established.
1998: The “Federation of Debrecen Universities” is founded.
2000. The federation is transformed into the unified “University of Debrecen” with all the relevant faculties and with some 20,000 students.

Debrecen is the traditional economic and cultural center of Eastern Hungary. In the 16th century Debrecen became the center of the Reformed Church in Hungary and later it was referred to as the "Calvinist Rome". The 17th century was regarded as the golden age of the city because Debrecen became the mediator between the three parts of Hungary: the part under Turkish occupation, the Kingdom of Hungary and the Principality of Transylvania. For short periods of time, Debrecen served twice as the capital of Hungary. Nowadays, with its population of approximately a quarter of a million, it is the second largest city in Hungary.
Debrecen is a unique city: although it has no mountains and rivers, its natural environment is rather interesting. One of the main attractions and places of natural uniqueness in Hungary is Hortobágy National Park, known as “puszta" (“plain”), which begins just in the outskirts of Debrecen. This is the authentic Hungarian Plain without any notable elevations, with unique flora and fauna, natural phenomena (e.g. the Fata Morgana), and ancient animal husbandry traditions. The region is unmatched in Europe, no matter whether one considers its natural endowments or its historic and ethnographic traditions. A very lovely part of Debrecen is the “Nagyerdő” (“The Great Forest”), which is a popular holiday resort. Besides a number of cultural and tourist establishments, luxurious thermal baths and spas, Nagyerdő accommodates the University campus too.
The history of higher education in Debrecen goes back to the 16th century when the College of the Reformed Church was established. The University Medical School of Debrecen has its roots in this spiritual heritage. It was in the year of the millennium of the establishment of Hungary (1896) when the foundation of the present University was decided. The University of Debrecen was established in 1912, initially having four faculties (Faculties of Arts, Law, Medicine and Theology). The University was officially inaugurated by King Charles IV of Hungary on October 23rd, 1918.
The educational activity at the University started in 1924, although the construction of the whole University was completed only in 1932. In 1951 the Faculty of Medicine became a self-contained,

independent Medical University for training medical doctors.
The special training of dentists began in 1976. As a further development the University Medical School established the Health College of Nyíregyháza in 1991. In 1993, as part of a nationwide program, the University was given the rights to issue scientific qualifications and new Ph.D. programs were also launched. Several new programs (e.g. the training of molecular biologists, pharmacists, general practitioners) were commenced in the '90s. The Faculty of Public Health was established in 1999, while the Faculty of Dentistry was founded in 2000.
The Faculty of Medicine celebrated the 90th anniversary of its foundation in October 2008 with a highly successful international scientific conference.

Education at the University of Debrecen
Debrecen, the second largest city of Hungary, is situated in Eastern Hungary. Students enrolled in the various programs (e.g. Medicine, Dentistry, Pharmacy, Public Health, Molecular Biology, etc.) study on a beautiful campus situated in the area called "Great Forest".
The Hungarian Government gives major priorities to the higher education of health sciences in its higher education policy. One of these priorities is to increase the ratio of college level training forms within the Hungarian higher education system. The governmental policy wishes to implement conditions in which the whole health science education system is built vertically from the lowest (post-secondary or certificate) to the highest (PhD-training) levels. In fact, this governmental policy was the reason behind the establishment of the new Health Science Education Center within the Federation of Debrecen Universities (DESZ), based partially on the intellectual resources of the University of Debrecen. The new programs – with specialized training for paramedics – will help to correct the balance of the Hungarian labor-market that became rather unsettled in the past few decades.
The Act of Higher Education (1993) has restored the rights of the medical universities to award postgraduate degrees and residency, and permission was also given to license Physicians' procedures. This kind of training required a new structure, a new administrative apparatus, and a suitable training center. The new residency programs were commenced in 1999.
The introduction of the credit system, starting in September 2003, has been mandatory in every Hungarian university, helping the quantitative and qualitative evaluation of the students' achievements. Admission requirements for Hungarian students are defined at national level, and they are applicable for every student wishing to be enrolled into the Medicine or Dentistry programs.
International students must pass an entrance exam in biology and (depending on their preference) in physics or chemistry. In some special cases it may be possible for the candidates to apply for transfer to higher years on the basis of their previous studies and achievements. International students study in English language. Entrance for certain courses of the Health College is also possible on the basis of a special evaluation (scoring) and an entrance interview.
The syllabuses and classes of all courses correspond to European standards. The total number of contact hours in medical education is over 5,500, which can be divided into three main parts: basic theoretical training (1st and 2nd year), pre-clinical subjects (3rd year) and clinical subjects (4th and 5th year) followed by the internship (6th year). The proportion of the theoretical and practical classes is 30% to 70%; whereas the students/instructors ratio is about 8/1. The first two years of dentistry education are similar to the medicine program, but the former contains a basic dental training that is followed by a three-year-long pre-clinical and clinical training. Besides the medicine and dentistry programs, there are several other courses also available, including molecular biology. The various Health College courses include more and more new curricula.
The Medicine program delivered in English and intended for international students was commenced in 1987; whereas the Dentistry and Pharmacy programs for international students started in 2000

and 2004, respectively. The curriculum of the English language Medicine program meets all the requirements prescribed by the European medical curriculum, which was outlined in 1993 by the Association of Medical Schools in Europe. Compared to the Hungarian program, the most important differences are:
-Hungarian language is taught,
-More emphasis is laid upon the tropical infectious diseases (as parts of the "Internal Medicine" and "Hygiene and Epidemiology" courses).
Otherwise, the English language curriculum is identical with the Hungarian one. The 6th year of the curriculum is the internship that includes Internal Medicine, Pediatrics, Surgery, Obstetrics and Gynecology, Neurology, and Psychiatry. The completion of these subjects takes at least 47 weeks, although students are allowed to finish them within a 24-month-long period. The successfully completed internship is followed by the Hungarian National Board Examination. Just like the rest of the courses, the internship is also identical in the Hungarian and English programs.
A one-year-long premedical (Basic Medicine) course, which serves as a foundation year, is recommended for those applicants who do not possess sufficient knowledge in Biology, Physics and Chemistry after finishing high school.
After graduation, several interesting topics are offered for PhD training, which lasts for three years. If interested, outstanding graduates of the English General Medicine and Dentistry programs may join these PhD courses ("English PhD-program"). Special education for general practitioners has been recently started and a new system is in preparation now for the training of licensed physicians in Debrecen.

The accredited PhD programs include the following topics:
-Molecular and Cell Biology; Mechanisms of Signal Transduction
-Microbiology and Pharmacology
-Biophysics
-Physiology-Neurobiology
-Experimental and Clinical Investigations in Hematology and Hemostasis
-Epidemiological and Clinical Epidemiological Studies
-Cellular- and Molecular Biology: Study of the Activity of Cells and Tissues under Healthy and Pathological Conditions
-Immunology
-Experimental and Clinical Oncology
-Public Health
-Preventive Medicine
-Dental Research

The PhD-programs are led by more than 100 accredited, highly qualified coordinators and tutors.

Medical Activity at the Faculty of Medicine
The Faculty of Medicine is not only the second largest medical school in Hungary, but it is also one of the largest Hungarian hospitals, consisting of 49 departments; including 18 different clinical departments with more than 1,800 beds. It is not only the best-equipped institution in the area but it also represents the most important health care facility for the day-to-day medical care in its region.
The Kenézy Gyula County Hospital (with some 1,400 beds) is strongly affiliated with the University of Debrecen and plays an important role in teaching the practical aspects of medicine. There are also close contacts between the University and other health care institutions, mainly (but not exclusively) in its closer region. The University of Debrecen has a Teaching Hospital Network consisting of 24 hospitals in Israel, Japan and South Korea.

It is also of importance that the University of Debrecen has a particularly fruitful collaboration with the Nuclear Research Institute of the Hungarian Academy of Sciences in Debrecen, allowing the coordination of all activities that involve the use of their cyclotron in conjunction with various diagnostic and therapeutic procedures (e.g. Positron Emission Tomography 'PET').

Scientific Research at the Faculty of Medicine

Scientific research is performed both at the departments for basic sciences and at the laboratories of clinical departments. The faculty members publish about 600 scientific papers every year in international scientific journals. According to the scientometric data, the Faculty is among the 4 best of the more than 80 Hungarian research institutions and universities. Lots of scientists reach international recognition, exploiting the possibilities provided by local, national and international collaborations. Internationally acknowledged research areas are Biophysics, Biochemistry, Cell Biology, Immunology, Experimental and Clinical Oncology, Hematology, Neurobiology, Molecular Biology, Neurology, and Physiology. The scientific exchange program involves numerous foreign universities and a large proportion of the faculty members are actively involved in programs that absorb foreign connections (the most important international collaborators are from Belgium, France, Germany, Italy, Japan, the UK and the USA).

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	Ms.	Ilona Mészáros M.Sc., Ph.D., C.Sc.
Assistant Professor	Ms.	Márta M-Hamvas M.Sc., Ph.D.
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	Gábor Lente M.Sc., Ph.D., D.Sc.
	Ms. Katalin Várnagy M.Sc., Ph.D., D.Sc.
Professor Emeritus	Ernő Brücher Ph.D.,D.Sc.,M.Sc.
	Ms. Etelka Farkas M.Sc., Ph.D., D.Sc.
	Imre Sóvágó M.Sc., Ph.D., D.Sc.
	Imre Tóth Ph.D.,D.Sc.,M.Sc.

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		István Lázár M.Sc., Ph.D.
		Gyula Tircsó M.Sc., Ph.D.
Assistant Professor	Ms.	Edina Baranyai M.Sc., Ph.D.
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	Ms.	Ágnes Dávid M.Sc.
	Ms.	Ágnes Grenács M.Sc., Ph.D.
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	Ms.	Tóth Éva Juhászné M.Sc., Ph.D.
		Attila Kiss M.Sc., Ph.D.
	Ms.	Krisztina Kónya M.Sc., Ph.D.
	Ms.	Tünde Zita Tóthné Illyés M.Sc., Ph.D.
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Academic Advisor	Ms.	Tóth Éva Juhászné M.Sc., Ph.D.

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	Máté Orosz

CHAPTER 7
UNIVERSITY CALENDAR

UNIVERSITY CALENDAR FOR MOLECULAR BIOLOGY MSC PROGRAM 2017/2018 ACADEMIC YEAR

OPENING CEREMONY: September 10, 2017
GRADUATION CEREMONY: June 2018

1st SEMESTER

Year	Course	Examination Period
1st year 2nd year	September 11 - December 22, 2017 (15 weeks)	December 27, 2017 - February 09, 2018 (7 weeks)

2nd SEMESTER

Year	Course	Examination Period
1st year	February 12 - May 25, 2018 (15 weeks)	May 28 - July 13, 2018 (7 weeks)
2ndyear	February 12 - May 04, 2018 (12 weeks)	May 07 - July 22, 2018 (7 weeks)

CHAPTER 8
CREDIT SYSTEM

ACADEMIC PROGRAM FOR CREDIT SYSTEM

The introduction of the credit system became compulsory in every Hungarian university, including the University of Debrecen by September, 2003. The aim of the credit system is to ensure that the students' achievements can be properly and objectively evaluated both quantitatively and qualitatively.
A credit is a relative index of cumulative work invested in a compulsory, a required elective or a freely chosen subject listed in the curriculum. The credit value of a course is based upon the number of lectures, seminars and practical classes of the given subject that should be attended or participated in (so called "contact hours"), and upon the amount of work required for studying and preparing for the examination(s). Together with the credit(s) assigned to a particular subject (quantitative index), students are given grades (qualitative index) on passing an exam/course/class. The credit system that has been introduced in Hungary meets the standards of the European Credit Transfer System (ECTS). The introduction of the ECTS promotes student mobility, facilitates more effective organization of students' exchange programs aimed at further education in foreign institutions, and allows recognition of the students' work, studies and achievements completed in various foreign departments by the mother institution. Credit-based training is flexible. It provides a wider range of choice, enables the students to make progress at an individual pace, and it also offers students a chance to study the compulsory or required subjects at a different university, even abroad. Owing to the flexible credit accumulation system, the term "repetition of a year" does not make sense any longer. It should be noted, however, that students do not enjoy perfect freedom in the credit system either, as the system does not allow students to randomly include subjects in their curriculum or mix modules. Since knowledge is based on previous studies, it is imperative that the departments clearly and thoroughly lay down the requirements to be met before students start studying a subject.

The general principles of the credit system are the following:

1. Students can be given their degree if, having met other criteria as well, they have collected 120 credits during their studies. Considering the recommended curriculum, this can be achieved in two years (four semesters).

2. According to the credit regulations, students should obtain an average of 30 credits in each semester.

3. The criterion of obtaining 1 credit is to spend 30 hours (including both contact and non-contact hours) studying the given subject.

4. Credit(s) can only be obtained if students pass the exam of the given subject.

5. Students accumulate the required amount of credits by passing exams on compulsory, required elective and freely chosen subjects. Completion of every single compulsory credit course is one of the essential prerequisites of getting a degree. Courses belonging to the required elective courses are closely related to the basic subjects, but the information provided here is more detailed, and

includes material not dealt with in the frame of the compulsory courses. Students do not need to take all required elective courses, but they should select some of them wisely to accumulate the predetermined amount of credits from this pool. Finally, a certain amount of credits should be obtained by selecting from the freely chosen courses, which are usually not related to the basic (and thus mandatory) subjects, but they offer a different type of knowledge.

6. 58, 19, 7 and 6 credits of the total of 120 credits should be accumulated by completing the compulsory, differentiated professional, oriented elective and freely chosen courses, respectively.
The curriculum in English program corresponds with the curriculum in Hungarian program.

7. The students qualified in molecular biology are required to know the principles of biology, to have general knowledge in the fields of natural sciences and to be familiar with the methods of scientific thinking and problem-solving approach.
The competency is based on the content of basic modules and the process of preparation of diploma thesis. Since the target can be reached mainly by collection and evaluation of knowledge, the lectures and seminars are important forms of education.
Besides the acquirement of knowledge, the professionals in molecular biology have to be able to recognize the problems, to elaborate the way of solution, to evaluate and interpret the results. From this respect, the practicals and the laboratory work during the making of diploma thesis offer good possibilities.
Nowadays there is an ever increasing demand for the skills regarding innovative activity, abilities for self-improvement of practical utilization of own results, and organization of individual activity. It can require some type of non-professional (legal, economical, management) knowledge, which can be achieved also by optional courses.
The students graduated in molecular biology master program know the most important results of molecular biology and the possibilities for their application, the approach and methodological tools of molecular biology, the structure and function of the human body to an extent necessary for acquirement of professional knowledge, the bases of genomics, medical immunology and microbiology, and have general knowledge in pharmacology. The differentiated professional subjects assure the acquirement of professional competencies. These subjects are offered in obligatory or oriented elective form. The topics are processed in lectures and practicals, which guarantee the acquirement of competencies. Considering the institutional characteristics and possibilities, it is warranted that in the given fields the highly qualified staff takes part in the education.

8. The pilot curricula show the recommended pacing of compulsory courses. If these courses are carefully supplemented with credits obtained from the necessary number of required elective and freely chosen courses, students can successfully accumulate the credits required for their degree within 4 semesters.

9. The diploma work is worth 30 credits.
The Degree thesis (dissertation) is a paper written about the individual scientific investigations in the field of molecular biology, which proves the profound knowledge of the student. It has to demonstrate, that the student became familiar with the basis of library and literature use as well as is able to formulate and document own opinion in adequate form, and defend the thesis in a debate taken before a professional committee.

10. Regulations concerning the training of students in the credit system prescribe a minimum amount of credits for certain periods as outlined in the Rules and Regulations for English Program

Students.

11. Although Physical Education is not recognized by credits, it have to be completed to get the final degree (see the rules outlined in the Information section about the conditions).

12. Evaluation of the students' achievements needed for grants or applications is described in Rules and Regulations for English Program Students.

13. Further information is available in the Rules and Regulations for English Program Students.

We very much hope that the system of training will contribute to the successful completion of your studies.
We wish you good luck with your university studies.

CHAPTER 9
ACADEMIC PROGRAM FOR CREDIT SYSTEM

Compulsory courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Biochemistry of Metabolism	AO_MBE_ACS01	30	15		ESE*	4	None
1	Biophysics	AO_MBE_BIF01	30			ESE	3	None
1	Human Physiology I.	AO_MBE_HET01	30			ESE*	3	None
1	Medical Genome Biology	AO_MBE_GRB01	30			ESE*	3	None
1	Medical Genome Biology Practicals	AO_MBE_GRG01			45	AW5	2	None
1	Methods of Molecular Biology	AO_MBE_MBE01	30			ESE*	3	None
1	Molecular Genetics	AO_MBE_GEN01	30		30	ESE*	4	None
1	Molecular Immunology	AO_MBE_IMM01	30	8		ESE*	3	None
1	Radioisotope Techniques in Biomedicine	AO_MBE_ITE01	30			ESE	3	None
1	Radioisotope Techniques In Biomedicine Practicals	AO_MBE_ITG01			15	AW5	1	together with Radioisotope Techniques in Biomedicine
2	Bioinformatics	AO_MBE_BIE02	30			ESE	3	None
2	Bioinformatics Practicals	AO_MBE_BIG02			15	AW5	1	together with Bioinformatics
2	Biostatistics	AO_MBE_BST02	15			ESE	1	None
2	Cell and Organ Biochemistry	AO_MBE_SBK02	30	15	15	ESE*	4	Biochemistry of Metabolism
2	Cell Biology	AO_MBE_SBI02	30	0	0	ESE*	3	None
2	Human Physiology II.	AO_MBE_HET02	30			ESE*	3	Human Physiology I.
2	Human Physiology Practicals	AO_MBE_HEG02			30	AW5	2	Human Physiology I; together with Human Physiology II
2	Methods in Molecular Biology Practicals	AO_MBE_MBG01			45	AW5	2	Methods of Molecular Biology
2	Physiology of Prokaryotes and Molecular Virology	AO_MBE_PRO02	30		15	ESE	4	None
2	Plant Molecular Biology	AO_MBE_NBI02	30	30		ESE	4	None
2	Problem-solving exercises in Molecular Biology	AO_MBE_PMF02			45	AW5	2	None

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics
Required elective courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Thesis I.	AO_MB_DD02			75	AW5	5	None
2	Structure and Function of Macromolecules	AO_MBE_MMS02	15		30	ESE	3	Medical Genom Biology

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics
Required elective courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Gene Expression Regulation – Functional Genomics	AO_MBE_GES03	15		30	ESE	3	Medical Genom Biology
1	Genomic Bioinformatics	AO_MBE_BGI02	15		30	ESE	3	Medical Genom Biology
1	Molecular Mechanism of Diseases Concerning Great Populations	AOG167605	25			AW5	2	None
1	Signalling Pathways in the Cells	AO_MBE_SJF03	30			ESE	3	Cell and Organ Biochemistry
1	Thesis II.	AO_MB_DD03			150	AW5	10	Thesis I.
2	Enzymology	AO_MBE_ENZ03	15		60	AW5	4	Biochemistry of Metabolism
2	Post-translational Modification of Proteins	AO_MBE_FPT04	30			ESE	3	Cell and Organ Biochemistry
2	Proteomics	AO_MBE_PRO04	30		30	ESE	4	Structure and Function of Macromolecules
2	Thesis III.	AO_MB_DD04			225	AW5	15	Thesis II.

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics
Module-specific Freely Chosen Courses for the 2. year

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Medical Chemistry	Bioinorganic Chemistry	AO_MBE_BSZ03	3	1	30	ESE	None	Ferenc Erdődi M.Sc., Ph.D., D.Sc.
Department of Biochemistry and Molecular Biology	Biochemistry of Apoptosis	AO_MBE_ABI03	3	1	30	ESE	Cell and Organ Biochemistry	Zsuzsa Szondy M.D., Ph.D., D.Sc.
Department of Biochemistry and Molecular Biology	Retroviral Biochemistry	AO_MBE_REB04	3	2	30	ESE	Cell and Organ Biochemistry	József Tőzsér M.Sc., Ph.D., D.Sc.

Freely Chosen Courses for the 2. year

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Immunology	Impaired Signal Transduction in the Immune System	AO_MBE_ITZ03	2	1	15	ESE	Molecular Immunology	Tamás Bíró M.D., Ph.D., D.Sc.
Department of Immunology	Basis of Conventional and Biological Immunotherapies	AO_MBE_HBI03	3	2	30	ESE	Impaired Signal Transduction in the Immune System	Árpád Lányi M.Sc.,Ph.D.
Department of Immunology	Immunological Methods In Molecular Biology	AO_MBE_IME02	3	2	30	ESE	Molecular Immunology	Péter Gogolák M.Sc.,Ph.D.
Department of Immunology	New System Biology Paradigms in Immunology	AO_MBE_UPI02	3	2	30	ESE	Molecular Immunology	Éva Rajnavölgyi M.Sc., Ph.D., D.Sc.

CHAPTER 10
ACADEMIC PROGRAM FOR THE 1ST YEAR

Department of Biochemistry and Molecular Biology

Subject: **BIOCHEMISTRY OF METABOLISM**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

1st week:
Lecture: The biology of the mitochondria I. Mitochondrial transport.The processes and regulation of citric acid cycle and oxidative phosphorylation.

2nd week:
Lecture: The biology of the mitochondria II. Oxidative phosphorylation 2. Anaplerotic reactions. The mitochondrial genome - maintenance and mutations.

3rd week:
Lecture: Carbohydrate metabolism I. Basic metabolic pathways, tissue-specific regulation of carbohydrate metabolism.

4th week:
Lecture: Carbohydrate metabolism II. Inherited diseases of carbohydrate metabolism. Biochemistry of diabetes.

5th week:
Lecture: Lipid metabolism I. Transport and processing of lipids in the digestive track and in the circulation. Covalent lipid-protein interactions, lipoprotein complexes. Synthesis and degradation of triacyl glycerols.

6th week:
Lecture: Lipid metabolism II. Metabolic changes during the well-fed state and during starvation. Ketone bodies. The mevalonate pathway. Synthesis of steroid hormones, bile acids, eicosanoids. Lipid peroxidation. Vitamin D metabolism.

7th week:
Lecture: Lipids in health and disease. Cholesterol synthesis, transport, storage and efflux - processes, regulatory mechanisms, drug treatment. The LDL receptor. Obesity and metabolic syndrome.

8th week:
Lecture: Nutrition: Vitamins.
Self Control Test (Topics of week 1-7.)

9th week:
Lecture: Protein structure I. Fundamentals of protein structure, determining the macromolecular structure of proteins. Hierarchy of protein structures, primary, secondary, tertiary, quaternary structures. Characteristics of alpha helices and beta sheets. Schematic representation of secondary structures, topological diagrams.

10th week:
Lecture: Protein structure II. Intrinsically disordered proteins.

11th week:
Lecture: Amino acid metabolism I. Production and utilization of the intracellular amino acid pool. Exogenous and endogenous sources of amino acids. Common reactions of amino acid metabolism: the fate of nitrogen. Production and efflux of ammonia.

12th week:
Lecture: Amino acid metabolism II. Inter-organ nitrogen transport. Processes and regulation of the urea cycle. C1-transfer, transmethylation,

monooxygenation and dioxygenation reactions. Diseases of amino acid metabolism.

13th week:
Lecture: Nucleotide metabolism I. The nucleotide pool. Digestion and absorption of nucleotides. De novo synthesis of purine nucleotides, regulation, salvage reactions.

14th week:
Lecture: Nucleotide metabolism II. De novo synthesis of pyrimidine nucleotides, regulation. Diseases of nucleotide metabolism. Antiviral and antitumor effect of nucleoside analogs.

15th week:
Lecture: Summary, consultation.
Self Control Test (Topics of week 8-14.)

Requirements

Course content:
Topics of metabolism presented at the lectures and discussed during the seminars (lecture slides are available at the http://bmbi.med.unideb.hu web site, username and password are provided at the beginning of the semester). At the seminars the lectures of the previous week and new scientific information connected to the lectures will be discussed with the seminar teacher.

Requirements:
Lecture attendance is not compulsory, but recommended: in case of two lecture absences the students will lose their seminar bonus points. Please arrive in time for the lectures, because the door of lecture hall will be closed at the beginning of the lecture. Three absences are accepted from the seminars - in case of more absences students will not be permitted to take the written exam. Absences are accepted for medical reasons, certain family reasons or scientific programs - please provide certificates to the course administrator before the end of the semester.

Self-control tests: (not obligatory) During the semester students may choose to write three self-control tests addressing the curriculum of the lectures and seminars. The self-control tests consist of single-choice and multiple-choice test questions, and by writing all three tests a total of maximum 80 points can be collected. If the combined score of the tests is above 60% of the total score, seminar bonus point are added to the test score, and grades will be offered based on the cumulative score at the end of the semester. If the offered grade is not accepted by the student, a written exam must be taken during the exam period.

Grading: Grades will be offered based on the combined score of the self-control tests plus seminar bonus points, or the score of the written examination plus seminar bonus points during the exam period, based on a five-grade scale. Seminar bonus points are added to the written exam test score only if the score is above 60%.

Self-control test grading:

Pass (grade 2):	48-55.5 points
satisfactory (grade 3):	56-63.5 points
good (grade 4):	64-71.5 points
excellent (grade 5):	72-80 points

The written exams consist of single-choice and multiple-choice test questions.

Written exam grading:

pass (grade 2):	60-69.5 points
satisfactory (grade 3):	70-79.5 points
good (grade 4):	80-89.5 points
excellent (grade 5):	90-100 points.

Students may take one improvement exam per exam period (for the offered grade or for the written exam).
Please follow the **announcements** of the department about the control tests, exams and other current information on the bulletin board (LSB downstairs, 1 corridor), and on the website.

Department of Human Genetics

Subject: **MEDICAL GENOME BIOLOGY**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction into genomics. Nanotechnology in medicine.

2nd week:
Lecture: The technology of DNA sequencing. introduction into evolutionary genome biology.
Practical: General information about the subject.

3rd week:
Lecture: Whole genome sequencing. Significance, examples, databases.
Practical: Preparatory class on sequence alignments.

4th week:
Lecture: Variability of the human genome. New generation sequencing.
Practical: Sequence alignments.

5th week:
Lecture: Biostatistics in global genome analysis.
Practical: Preparatory class on databases.

6th week:
Lecture: Global proteome analysis.
Practical: Databases.

7th week:
Lecture: Analysis of protein sequences and structures. Protein databases.
Practical: Preparatory class on gene expression analysis.

8th week:
Lecture: Global analysis of gene expression.
Practical: Gene expression analysis.

9th week:
Lecture: Gene and proteome profiling in the diagnostics.
Practical: Preparatory class on polymorphisms.

10th week:
Lecture: Applied genome analysis in drug research.
Practical: DNA polymorphisms I.

11th week:
Lecture: Biomarkers in diagnostics. History of genome science, biotechnology, philosophical aspects.
Practical: DNA polymorphisms II.

12th week:
Lecture: Antibody-based proteomics in cancer diagnostics.

Practical: Preparatory class on genome-browsers.

13th week:
Lecture: Gene maps and polygenic diseases.
Practical: Genome browsers.

14th week:
Lecture: Integrative biology, genome-scale information.
Practical: Consultation.

15th week:
Lecture: Genomics of complex diseases.
Practical: Genomics of complex diseases.

Requirements

The program consists of lectures and seminars. Attendance of lectures is important, because the material which is required at the examination is presented here. Therefore, participation on at least 50 % of the lectures is compulsory. If the number of absences exceeds 50 % of the lectures the signature will be rejected.
Attendance at the seminars is also important. If the student misses more than 2 seminars, he or she will have to take a test ("labtest") to qualify for the signature. If the student has more than 4 absences from the seminars, the signature will be rejected and the semester must be repeated.
End of semester examination:
15-20 short essay questions are given to each student.

Grading of the papers is the following:

0-49,99 %:	fail (1)
50-59,99 %	pass (2)
60-69,99 %:	satisfactory (3)
70-79,99 %	good (4)
80-100 %:	excellent (5)

Academic advisor: Professor László Takács, laszlo.takacs@biosys-intl.com
Course coordinator: Dr. András Penyige, penyige@med.unideb.hu
The slides of the lectures and up-to-date information can be found at https://elearning.med.unideb.hu, username and password is your network-id (same as Neptun-id) and password. You will be able to check the content after the Neptun has registered you to the subject.
Departmental homepage: https://humangenetics.unideb.hu

Subject: **MEDICAL GENOME BIOLOGY PRACTICALS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Practical: **45**

2nd week:
Practical: General information about the subject.

3rd week:
Practical: Preparatory class on sequence alignments.

4th week:
Practical: Sequence alignments.

5th week:
Practical: Preparatory class on databases.

6th week:
Practical: Databases.

8th week:
Practical: Gene expression analysis.

9th week:
Practical: Preparatory class on DNA polymorphisms.

10th week:
Practical: DNA polymorphisms and disease I.

11th week:
Practical: DNA polymorphisms and disease II.

12th week:
Practical: Preparatory class on genome browsers.

13th week:
Practical: Genome browsers.

14th week:
Practical: General consultation.

15th week:
Practical: Genomics of complex disesases.

Requirements

The slides of the lectures and up-to-date information can be found at https://elearning.med.unideb.hu, username and password is your network-id (same as Neptun-id) and password. You will be able to check the content after the Neptun has registered you to the subject.
Departmental homepage: https://humangenetics.unideb.hu

Subject: **MOLECULAR GENETICS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**
Practical: **30**

1st week:
Lecture: 1. Introduction into molecular genetics. 2. Organization of genetic material in pro- and eukaryotic cells.
Practical: Methods of study, required and advised readings. Laboratory safety in the laboratory. Nucleus and chromatin. Cell division.

2nd week:
Lecture: 3. Cytogenetics I. Karyogram, ideogram, banding techniques. Human autosomal trisomies. 4. Cytogenetics II. Abnormalities of the X and Y chromosomes. Structural aberrations of human chromosomes.
Practical: Cytogenetics. Evaluation of karyograms

3rd week:
Lecture: 5. Cytogenetics III. Sex determination in humans. Molecular cytogenetics. 6. The function of genes. Gene expression.
Practical: Gene structure, function (gene, DNS replication, transcription, translation).

4th week:
Lecture: 7. Genetic code. Translation. 8. Bacterial genetics.
Practical: Gene regulation in prokaryotes. Bacterial genetics.

5th week:
Lecture: 9. Gene regulation in prokaryotes. 10. The structure of the genes and gene regulation in eukaryotes. The genes of immunglobulines.

Practical: Gene regulation in eukaryotes.
Self Control Test (1st self-control test in extra time.)

6th week:
Lecture: 11. Epigenetics. Imprinting. Uniparental disomy. 12. Repair of the DNA. Mutagenic agents. Ames test. Dinamic mutations.
Practical: Mutation, repair, Ames-test.

7th week:
Lecture: 13. Molecular genetics of the cell cycle. 14. Transmission genetics. Genes and alleles. Genotype and phenotype. Monohybrid cross. Mendel's 1st law. Reciprocal cross and test cross. Different types of inheritance.
Practical: Oncogenes and tumorsupressors.

8th week:
Lecture: 15. Multiple alleles. Dominant and recessive genes: phenotypes and a molecular view.. 16. Genetic polimorhism I. Allelic polymorhism. X-linked genes. Note: lectures will be held on an other day because Monday will be holiday.
Practical: Problem solving and seminar on mendelian genetics.

9th week:
Lecture: 17. Dihybrid cross. Mendel's 2nd law and meiosis. Linked and not-linked genes. Recombination of non-allelic genes. Genetic mapping. 18. Gene interactions, epistasis, lethal genes. Variations of the gene expression. LOD score.
Practical: Pedigree analysis. Basic of the human genetics. Seminar on molecular genetics of inherited human diseases.

10th week:
Lecture: 19. Extranuclear inheritance. Mutations in mitochondrial genes. 20. Genetic polymorphisms II. Human genetic diversity. Genetics of blood types.
Practical: Study of sex chromatin. Demonstration of mammalian chromosomes. Preparation of metaphase spreads.
Self Control Test (2nd self-control test in extra time.)

11th week:
Lecture: 21. Genetic polymorphisms III. Genetics of MHC. DNS-polymorphisms as alleles: RFLP, SNP, micro- és minisatellites. Copy number variations. 22. The genetic basis of complex inheritance.
Practical: Transformation of Escherichia coli.

12th week:
Lecture: 23. Genetic polymorphisms IV. Pharmacogenetics, pharmacogenomics. 24. Applications of modern genetics in clinical diagnosis. Genetics of pregnancy and prenatal vitamins. Personalized medicine. Ecogenetics and ecogenomics.
Practical: Complementation test. The gene concept.

13th week:
Lecture: 25. Population genetics. Hardy-Weinberg equilibrium. Inbreeding. Genetical basis of evolution. 26. Transposable elements.
Practical: Detection of human DNA polymorphism by polymerase chain reaction.

14th week:
Lecture: 27. The genetic role of RNA. 28. Developmental genetics.
Practical: Seminar on population genetics.
Self Control Test (3rd self-control test in extra time.)

15th week:
Lecture: 29. Clinical applications of new biotechnology techniques. 30. Results of Human Genom Project.
Practical: PCR evaluation of the human polymorphism experiment. Induction of beta-galactosidase in E. coli cells.

Requirements

Conditions of signing the lecture book:

1, Attendance

Concerning attendance, the rules laid out in the EER of the University are clear. The presence of students at laboratory practices and seminars is obligatory and will be recorded. **Students are responsible for signing the list of attendance.** The professor refuses his/her signature in the student's Lecture Book for the semester's course-work in the case of over four weeks of absence, even if the student has an acceptable excuse.

If the student is absent from more than two practices or seminars (taken together), the semester will be accepted only if they pass an examination based on the material covered by the laboratory classes and seminars of the semester (lab test).

Successful accomplishment of the laboratory practices will be controlled by signing the laboratory notes. If 3 or more practices will not be accepted, the lecture book will not be signed. These students must sit for a written exam from the laboratory material.

The lab notes for the experiments should contain the followings:

Part made at home during the preparation:

1. The title of the experiment
2. The basic principle of the experiment
3. Description of the used method(s)

Part that should be made not later than next week lab:

4. The results of the experiment
5. Conclusions drawn from the experiment

If these are not prepared the lab instructor dismisses the student from the class.

The presence of students on at least 50% of lectures is obligatory and will be recorded. The professor refuses his/her signature in the student's Lecture Book for the semester's course-work if the student was absent from more than 17 lectures, even if the student has an acceptable excuse.

2, Self-control tests

During the semester there will be **three self-control tests** offered in the 5th, 10th and 14th weeks. Participation in at least two of them is required for the signature. The questions include multiple choice and short essay questions, figures, pedigrees, definitions, problems, etc. The questions are selected from a question bank that will be published on the departmental home page (except the multiple choice questions). Based on the % average of the **three tests** a final grade will be offered according to the next table:

Percentage (%)	Grade
60.00 - 64.99	pass (2)
65.00 - 74.99	satisfactory (3)
75.00 - 84.99	good (4)
85.00 - 100	excellent (5)

Those students who want a better mark have to take the regular end of semester “A” exam. The

result of this ESE is binding, it can be better, the same or worse than the offered mark. Students with lower achievement than 60 % should take the regular ESE.

Exemption requests:
Applications for exemption (based on previous studies in other universities) should be submitted during the first two weeks of the semester. Requests are not accepted after that deadline! Exemption is granted only, if the student can pass an "Assessment of knowledge" test. The passing limit is 50%.

Rules concerning repeaters:
Attendance of labs and seminars for those repeaters who have a signed lecture book from the previous year (i.e. they failed, or they are repeaters because they have never taken Molecular Genetics exam) is dispensable. Students should register for the subject electronically during the first weeks of the semester. They can take the three midterm tests in order to qualify for offered grade or test bonuses and they take the regular exam at the end of the semester. They cannot have home-work bonuses. Students, who did not earn a signature in the previous year, have to register and attend the labs and seminars and they are considered as the other students registering the course at the first time.

End of Semester Examination (ESE):
There will be a written examination at the end of the semester (ESE) that covers all the material of the semester taken in the lectures, seminars, laboratory practices and required parts of the textbook (for a detailed list see the University Bulletin). The examination questions include multiple choice and short essay questions, figures, definitions, etc. The marks are based on the student's performance, expressed in percentage (%) as shown in the table below:

Percentage (%)	Grade
0 - 49.99	fail (1)
50.00 - 64.99	pass (2)
65.00 - 74.99	satisfactory (3)
75.00 - 84.99	good (4)
85.00 - 100	excellent (5)

The percentage values include the student's performance at the ESE as well as the bonus percentage they have obtained by taking the three mid-semester tests.
The following table shows the bonus percentage based on the average result of the semester tests. Absence counts as 0%.

Average of the 3 tests (%)	Bonus (%)
50.00 - 53.99	1
54.00 - 57.99	2
58.00 - 61.99	3
62.00 - 65.99	4
66.00 - 69.99	5
70.00 - 73.99	6

74.00 - 77.99	7
78.00 - 81.99	8
82.00 - 85.99	9
86.00 - 100	10

Further bonuses can be given for the timely completion of the following midterm homeworks:
Problem solving in genetics (1 bonus)
Analysis of human karyograms (1 bonus)
Data search in human genetic databanks through the Internet (1 bonus)
Problem solving in population genetics (1 bonus)

Only those home works are accepted for evaluations which are turned in within one week after the students receive them. The submission of the home-works is voluntary. Home-works are not accepted after the submission deadline

Bonuses are calculated only in the year of acquisition.
Lecture and seminar files, hand-outs and up-to-date information can be found at https://elearning.med.unideb.hu, username and password is your network-id (same as Neptun-id) and password. You will be able to check the content after the Neptun has registered you to the subject.
Departmental homepage: https://humangenetics.unideb.hu

Department of Immunology

Subject: **MOLECULAR IMMUNOLOGY**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **8**

1st week:
Lecture: Elements of the immune system and their role in defense against pathogens. Components and cells of the innate response. Characteristics and function of the innate immune response. The structure of lymphoid tissues and organs.

2nd week:
Lecture: Structure and function of proteins encoded by the major histocompatibility (MHC) gene complex. Processing and presentation of antigens. T-lymphocytes. Requirements and consequences of T-cell activation.

3rd week:
Lecture: B-lymphocytes. Characteristics of the acquired immune response. An introduction to antibody structure and function. Lymphatic circulation, immune surveillance by re-circulation of immunocytes within the immune system. Inflammation and the acute phase response.

4th week:
Lecture: Recognition of pathogens by the innate arm of the immune system. Elimination of pathogens by the innate arm of the immune system. The complement system.
Seminar: Components and cells of the innate response. Characteristics and function of the innate immune response. Lymphatic circulation, immune surveillance by re-circulation of immunocytes within the immune system.

Inflammation and the acute phase response.

5th week:
Lecture: Generation of B-cell receptor diversity. Antigen-independent differentiation of B-lymphocytes. T-cell development. Central tolerance.
Seminar: The innate arm of the immune system. The complement system.
Self Control Test

6th week:
Lecture: Antigen presenting cells. Effector function of helper T-cell. Activation and function of cytotoxic T-lymphocytes.
Seminar: Generation of B-cell receptor diversity. Antigen-independent differentiation of B-lymphocytes. T-cell development. Central tolerance.

7th week:
Lecture: Mechanisms of peripheral tolerance. The function of regulatory T-cells. Antigen-dependent differentiation of B-lymphocytes.
Seminar: Antigen presenting cells. Effector function of helper T-cell. Activation and function of cytotoxic T-lymphocytes.

8th week:
Lecture: B-cell activation. Production of various antibody isotypes and their functions. The primary and secondary immune response. The development of immunological memory.
Seminar: Mechanisms of peripheral tolerance. The function of regulatory T-cells.

9th week:
Seminar: Differentiation and activation of B-lymphocytes. Production of various antibody isotypes and their functions. The development of immunological memory.

10th week:
Self Control Test

Requirements

Signing of the Lecture Book:
Participation in the Seminars is compulsory, no absences are allowed. If there is any absences, the Department shall refuse to sign the students' Lecture book.

Self control tests (SCTs), offered grades, end-term exam:
During the semester two self control test (SCT) will be organised (weeks 5 and 10).
The first SCT contains the material of the lectures of weeks 1-3 as well as the material of seminar on week 4. To ensure a solid basic knowledge of immunology, students must score higher than 70% to qualify for the 2nd SCT, hence for an offered grade.
The 2nd SCT contains the material of lectures 4-8, resptectively including the materials of the corresponding seminars.
If a student's score for the first SCT is higher than 70% and is higher than 50% for the 2nd SCT, she/he will be offered a grade. Should student accept this offered grade, she/he will be exempted from the end-term exam.
The offered grades are calculated by the following algorithm, based on the cumulative percentage points of the two SCTs (i.e. 200 points maximum).

120 - 139:	pass (2)
140 - 159:	satisfactory (3)
160 - 179:	good (4)
180 – 200:	excellent (5)

Those students who have not qualified for an offered grade must take the end-term exam during the

exam period. The end-term exam consists of a written and an oral part.
"A" exam: To qualify for the oral part of an "A" exam, students must score higher than 70% on the written (entry) exam. Students who score less than 70% on the written part will fail (thus, the oral exam will not take place).
"B" exam: "B" exams are identical to "A" exams except when the student failed the oral, but not the written, part of the "A" exam. With a score of higher than 70% on the written part of the "A" exam, the student is exempt from the written exam on the "B" exam.
"C" exam: "C" exams are oral exams only, without a written entry test.
Those students who would like to improve the grade of a successful ("A" or "B" exam) or do not accept the offered grade, are also exempted from the entry test.
The list of exam topics is available on the departmental website (www.immunology.unideb.hu).
Lecture materials and other information concerning education can be found on our website at www.immunology.unideb.hu

Department of Medical Chemistry

Subject: **METHODS OF MOLECULAR BIOLOGY**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Isolation of nucleic acids (DNA and RNA) from biological sources, agarose gel electrophoresis

2nd week:
Lecture: Enzymes of nucleic acid investigation, cloning of DNA

3rd week:
Lecture: Generation and screening of DNA libraries

4th week:
Lecture: DNA and RNA hybridization techniques, DNA chips1st self-control test from the topics of weeks 1-3

5th week:
Lecture: In situ hybridization, FISH and CGH

6th week:
Lecture: Synthesis of oligonucleotides, Polymerase Chain Reaction aplications, in vitro mutagenesis

7th week:
Lecture: DNA sequencing, genome projects

8th week:
Lecture: Purification of proteins, peptide synthesis2nd self-control test from the topics of weeks 4-7

9th week:
Lecture: Preparation of antibodies, analysis of proteins by immunological methods

10th week:
Lecture: Peptide sequencing, proteomics

11th week:
Lecture: Detection and quantitative analysis of protein-protein interactions 3rd self-control test from the topics of weeks 8-10

12th week:
Lecture: Expression systems for the production of recombinant proteins, transgenic plants

13th week:
Lecture: Biotechnology, fungal expression systems

14th week:
Lecture: Genetic manipulations: gene silencing, gene replacement, KO animals, gene therapy

15th week:
Lecture: 4th self-control test from the topics of weeks 11-14

Requirements

The program consists of a series of lectures that aim to extend the molecular biology knowledge of the first year MSc. students and provide a solid methodological basis for experiments to be performed in the next semester during molecular biology practical. It covers molecular biology approaches to complex problems, reveals the available methods and offers essential theoretical knowledge that can be used both in applied and research fields. The course is divided into four teaching blocks: 1st block: weeks 1-3 2nd block: weeks 4-7 3rd block: weeks 8-10 4st block: weeks 11-14 During the semester four written self-control test will be held to evaluate the midterm progress of the students. The results of these tests can be used as an offered grade for selected or for all of the blocks of questions at the end of semester exam (ESE), provided the student accepts these marks in a letter sent to the program coordinator before the start of the examination period. In the absence of such a letter all of the midterm marks will be erased at the beginning of the exam period. ESE is a written test composed of four blocks of questions, each covering a given teaching block as described above. The knowledge of each block at least at the basic level is required for the passing grade.
Both self-control and ESE tests will be evaluated according to the following table:

Percentage (%)	Mark
0-50	fail (1)
51-60	pass (2)
61-70	satisfactory (3)
71-80	good (4)
81-100	excellent (5)

Department of Physiology

Subject: **HUMAN PHYSIOLOGY I.**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Foundations of cellular physiology. Homeostatic parameters of human body.

2nd week:
Lecture: Membrane potentials and action potentials.

3rd week:
Lecture: Compartmentalization of body fluids.

4th week:
Lecture: Compartments of blood plasma and function of blood proteins.

5th week:
Lecture: Electrical properties of the heart.

6th week:
Lecture: Contractile properties of the heart.

7th week:
Lecture: Principles of hemodinamics.

8th week:
Lecture: Circulation of special areas (pulmonary, cerebral, coronary, splanchnic, cutaneous and muscular).

9th week:
Lecture: Regulation of the circulatory system.

10th week:
Lecture: Microcirculation.

11th week:
Lecture: Respiratory system.

12th week:
Lecture: The gastrointestinal tract. Nutrition, digestion, absorption I.

13th week:
Lecture: The gastrointestinal tract. Nutrition, digestion, absorption II.

14th week:
Lecture: Thermoregulation.

15th week:
Lecture: Neuromuscular transmission, functions of smooth and skeletal muscles.

Requirements

1. Signature of Lecture Book
Attendance oft lectures is compulsory. If one has more than 2 lecture absences, the end-semester examination (ESE) may not be substituted with the average test score (see later). For continuous updates on all education-related matters, please check the departmental web-site (http://PHYS.MED.UNIDEB.HU).

2. Evaluation during the semester (mid-semester tests)
The knowledge of students will be tested 2 times per semester in the form of a written test (multiple choice questions). Participation on mid-semester written tests is compulsory.

3. Examination
The first semester is closed by an end-semester exam (ESE) covering the topics of all lectures. The A and B chances of the end-semester exams are written tests (multiple choice questions), while the C chance is an oral exam. The grade of the written test is calculated according to the following table:

Scoremark	
0 – 59.9 %	fail
60 – 69.9 %	pass
70 – 79.9 %	satisfactory
80 – 89.9 %	good
90 – 100 %	excellent

ESE grade based on the average score of mid-semester tests will be offered if one's average score of the three mid-semester tests is above 60% and none of the individual tests' results are less than 40%. and (s)he has fewer than 3 lecture absences (see the table above).
- If one is not satisfied with the offered grade, (s)he may participate in ESE during the examination period. In his case the previously offered grade is cancelled.

Division of Biophysics

Subject: **BIOPHYSICS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: 1. Introduction. Electromagnetic waves, the properties of light (interference, photoelectric effect, photon theory). Matter waves.
2. X-ray, X-ray crystallography.
Seminar: Although there are no Biophysics seminars in Molecular Biology MSc training program, we encourage students to attend one General Medicine or Dentistry Biophysics seminar. (See timetable on the webpage of Department of Biophysics and Cell Biology.) Please notify the manager of education your seminar attendance.

2nd week:
Lecture: 3. Thermal radiation, light absorption and emission. Atomic and molecule spectra, absorption spectroscopy.
4. Fluorescence spectroscopy, application of fluorescence.

3rd week:
Lecture: 5. Lasers and their application in medicine.
6. Optics, optical microscopy, electron microscopy.

4th week:
Lecture: 7. Physical properties of sound, ultrasound, Doppler effect. Medical applications of ultrasound.
8. Nuclear physics. Nuclear binding energy, radioactivity, law of radioactive decay, radioactive series.

5th week:
Lecture: 9. Features of nuclear radiation and its interaction with absorbing material. Detection of radiation.
10. Radiation biophysics: target theory, direct and indirect action of radiation. Dosimetry. Biological effects of radiation.

6th week:
Lecture: 11. Experimental and diagnostic application of isotopes. Accelerators, Gamma camera.
12. Principles of tomographic methods. PET, SPECT and X-ray absorption CT.

7th week:
Lecture: 13. Basic principles of Nuclear Magnetic Resonance (NMR) and Electron Spin Resonance (ESR).
14. Magnetic resonance imaging (MRI). Magnetic resonance spectroscopy (MRS).

8th week:
Lecture: 15. Free enthalpy, chemical potential. Thermodynamic probability, Brownian motion, osmosis.
16. Diffusion at the molecular level, statistical interpretation. Fick's I and II Law.

9th week:
Lecture: 17. The structure of biological membranes. Membrane transport.
18. Thermodynamic equilibrium potentials (Nernst, Donnan). Diffusion potential, Goldman-Hodgkin-Katz equation.

10th week:
Lecture: 19. Resting potential, action potential, and electrical excitability. Measurement of membrane potential.
20. Ion channels (gating, selectivity), the "patch clamp" technique.

11th week:
Lecture: 21. The physical background of ECG and EEG.
22. Fluid mechanics, blood circulation.

12th week:
Lecture: 23. The human ear. Mechanism of hearing. The Weber-Fechner law.
24. The human eye. Photoreceptors. The molecular mechanism of vision.

13th week:
Lecture: 25. Biomechanics.
26. Flow cytomtery and its application in medicine.

14th week:
Lecture: 27. Biophysics of respiration.
28. Modern microscopic techniques, near field, atomic force microscopy, confocal laser scanning microscopy.

15th week:
Lecture: 29. Research in the Institute.
30. Preparation for the exam: questions, answers.

Requirements

Aim of the course:

To provide the necessary theoretical and practical background for the understanding the physical principles applied in biology and medicine, and for the description of the physical processes in living organisms.
To introduce the biophysical techniques in order to (1) understand the pathomechanism of diseases (2) develop of novel therapeutic approaches (3) develop of novel diagnostic tools: e.g. ECG, MRI, PET (4) understand the operation of cells, tissues and organs at the molecular level (5) provide a solid background for Physiology, Clinical Physiology, Radiology

Short description of the course:
Students will be introduced to the quantitative description of the physical basis of selected topics in biology and medicine. Structure of the course: (1) Introduction to natural sciences (e.g. basic principles of atomic and nuclear physics) (2) Medical physics (e.g. physical principles of diagnostic and therapeutic procedures) (3) Molecular biophysics (e.g. diffusion, membrane biophysics) (4) Organ biophysics (e.g. vision, hearing, circulation)

Compulsory reading: Medical Biophysics (Editors.: S. Damjanovich, J. Fidy, J. Szöllősi, Medicina, Budapest, 2009, ISBN: 978-963-226-127-0)
Educational material published on the web page of the Department.

Web page of the Department: http://biophys.med.unideb.hu/en

Exam: Oral exam during the exam period after the 1st semester.

1. Lectures
Attendance to lectures is not compulsory but emphatically recommended. All material covered in lectures is an integral part of the subject and therefore included in the self-control tests and the final exam. Some new concepts and ideas are discussed in the lectures only and are not present in the textbook.

2. Seminars
No seminars are included in the course, however, it is recommended to attend the seminars of the medicine students, which might aid preparation for the exam.

3. Practicals
There are no practicals included in the course.

4. Exemptions
In order to get exemption from the biophysics course the student has to write an application to the Educational Office. The Department of Biophysics and Cell Biology does not accept such applications. The following documents have to be submitted: 1. application with an explanation why the student thinks that he/she is eligible for an exemption; 2. certificates about the courses the student has taken; 3. a reliable description of the curriculum of the courses taken. An application is either rejected or accepted and exemption granted, or in most cases, students applying for an exemption will be examined by the Biophysics Chairman before granting an exemption. Applicants will be notified by the Department whether they have to take such an examination.

5. Conditions for signing the lecture book: no special requirements.

6. Self-control tests
There will be 2 self-control tests (SCT) during the semester. None of the SCTs are obligatory. Each SCT will be graded (0-100 %, 0% for absence) and the results of the two SCTs will be averaged (Xave). The missed test will be counted as 0% in the average. Missed SCTs cannot be made up at a later time.

Based on the written tests students may be offered the following grades:

55-64.99:	pass (2)
65-74.99:	satisfactory (3)
75-84.99:	good (4)
85-100:	excellent (5)

7. Final Examination (FE)

Final Examination (FE): Students have three chances (A, B, C) for passing the biophysics final exam in the winter exam period after the semester in which the course was taken.

The FE consists of two parts:

Part I. Minimum requirement questions. It consists of a written quiz of 20 minimum requirement questions. One must pass this part to continue with the oral exam (part II.). Minimum requirement questions and the answers thereto are provided on the website of the Department (biophys.med.unideb.hu). 16 out of 20 have to be answered correctly in order to pass this part. This part of the FE is evaluated as pass or fail, once passed it is valid for further exam chances (B- or C-chance) of the FE.
Part II. Students take an oral exam, where two questions chosen from the topic list (provided on the departmental website) at random should be answered. In order to complete the exam successfully students need to get pass (2) for both questions. Students are exempted from the FE exam if the grade offered based on the self-control tests is accepted by the student (see point 6.)

8. Rules for calculator usage during self-control tests and the final examination
In order to ensure a fair evaluation, to avoid disturbances in the testing room, and to protect the security of the test material the following types of calculators are NOT permitted:
- calculators with built-in computer algebra systems (capable of simplifying algebraic expressions)

- pocket organizers, handheld or laptop computers
- any device capable of storing text. Calculators with a typewriter keypad (so-called QWERTY devices), electronic writing pads and pen-input devices are not allowed either. Calculators with letters on the keys (e.g. for entering hexadecimal numbers or variable names) are permitted as long as the keys are not arranged in QWERTY format.
- Calculators or other devices capable of communicating with other devices
- Calculators built into wireless phones
- Calculators with paper tape or models that make noise

In general, students may use any four-function, scientific or graphing calculator except as specified above. However, we reserve the right to prohibit the usage of ANY type of calculator, computer and data storage and retrieval device during some tests if no calculations or only very simple calculations are necessary. Sharing calculators during tests is not allowed, and the test proctor will not provide a calculator.

9. Information for repeaters
- repeating the course means attending the lectures
- according to the relevant rules (point 6) self-control tests may be written and grade may be offered again
- the results of the self-control tests written in the failed semester are lost exemption from minimals obtained in the exam period of the failed semester is lost.

10. Information for exam course students
Points 1-6 and 9 are irrelevant. Point 7 and 8 applies fully. Results of the self-control test written in the previous semester are lost. Exemptions from minimals obtained in a previous exam period is lost.

Further information: Zsolt Fazekas, Ph.D., manager of education, Dept. of Biophysics and Cell Biology
E-mail: biophysedu@med.unideb.hu

Office hours: The location and time of office hours are shown in the News section of the Department's web page.

Division of Nuclear Medicine and Translational Imaging

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE PRACTICALS**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Practical: **15**

10th week:
Practical: Half life and gamma spectrum

11th week:
Practical: Labeling and gamma measurement

12th week:
Practical: In vitro isotope diagnostics (RIA)

13th week:
Practical: Dosimetry

14th week:
Practical: Liquid scintillation measurement

Requirements

Aim of the course (partial/complete skills and competencies):
To provide participants with practical training in basic methodologies of analytical laboratory work with radioisotopes. The course will broaden the participants' knowledge of methodological approaches, thus establishing later applications in practice.

Topics:
measuring half-life and dead time; characteristic curve of a GM tube; gamma spectra; absorption and self-absorption of beta radiation; liquid scintillation counting: efficiency; protein labeling with I-125; dosimetry
Practical 15, 5x3 hours

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE**
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction: radioisotopes in biomedicine.
Basic of atomic physics, decay modes

2nd week:
Lecture: Analytical methods with radiotracers

3rd week:
Lecture: Interactions of radiation with matter

4th week:
Lecture: Scintillation detection of gamma and beta radiation

5th week:
Lecture: Setting for measuring radiation. Gas ionization detectorsimits

6th week:
Lecture: General safety regulation, rules of working with radioisotopes. Compulsary before practices!

7th week:
Lecture: Basic terms and devices of dosimetry. Dose limits.
Biological effects of radiation.

8th week:
Lecture: Labeling techniques, autoradiography

9th week:
Lecture: Experimental error calculations, error propagation

10th week:
Lecture: "In vitro" isotope diagnostics

11th week:
Lecture: Characteristics and quality control of radiopharmaceuticals

12th week:
Lecture: Analyzing receptor binding and kinetics

13th week:
Lecture: "In vivo" nuclear medicine

14th week:
Lecture: Students' presentations

Requirements

Aim of the course (partial/complete skills and competencies):
To get acquainted with the possibilities of applying radioisotopes in biological and medical research, and the safety rules of handling radionuclides.

Topics:
basics of atomic physics, decay modes, law of decay; interactions of radiation with matter; methods and devices for detecting radiation: gas ionization and scintillation detectors, liquid scintillators, autoradiography; evaluation of the results of measurements; basic terms and devices of dosimetry; dose calculations; radiation protection, the biological effects of radiation; basic rules of working with radioisotopes, general safety regulations; applications: protein labeling techniques, analyzing receptor binding and kinetics, molecular biology

Department of Biochemistry and Molecular Biology

Subject: **BIOINFORMATICS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction to bioinformatics

2nd week:
Lecture: Definition of 'omics'. Sequencing technologies. Functional genomics approaches, connection with bioinformatics. The human genome project.

3rd week:
Lecture: The basics of database technology. Databases in molecular biology. Primary databases.

4th week:
Lecture: Protein and protein domain databases. Special emphasis on the UNIPROT and INTERPRO databases.

5th week:
Lecture: Other databases. The TAXONOMY, evolutionary and GO databases.

6th week:
Lecture: Text searches in databases. Using the text search engines of Google and the main bioinformatics portals. Usage of PubMed, Entrez and SRS.

7th week:
Lecture: Algorithms for similarity searches. Pairwise alignments. The DOTPLOT method, local and global analyses.

8th week:
Lecture: Similarity searches in databases. The FASTA and BLAST algorithms and their usage. The BLAST and MEGABLAST program. Multiple alignments.

9th week:
Lecture: Bioinformatics program packages for molecular biology. Introduction to the EMBOSS program package.

10th week:
Lecture: Introuction to the main programs in the EMBOSS program package.

11th week:
Lecture: Bioinformatic aspects of molecular phylogenetics. Multiple alignment and the evolutionary tree. Distance and character based methods.

12th week:
Lecture: Structural bioinformatics

13th week:
Lecture: Transcriptomics and bioinformatics.

14th week:
Lecture: Bioinformatics for next generation sequencing. Short read alignment, analysis of ChIP-seq and RNA-seq data, de novo genome assembly. The GWAS technology.

Requirements

Requirements for oral examination:
Participation in the obligatory lectures. Only one absence is accepted from the obligatory lectures - in case of more absences students will not be permitted to take the oral exam.

Grading: Grades will be offered based on oral examination during the exam period. The student's performance will be assessed on a five-grade scale. The list of exam topics and the examination rules will be announced by the Department at the beginning of the semester (lecture slides are available at the http://bmbi.med.unideb.hu web site, username and password are provided at the beginning of the semester). Students may take one improvement exam per exam period.

Subject: **BIOINFORMATICS PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **15**

2nd week:
Practical: Using the sequence and domain databases. Downloading and analysis of sequence records from the EMBL, GenBank and SwissProt databases. Searching the INTERPRO database. Possible usages of SRS text search.

3rd week:
Practical: Annotation of novel metagenomic sequences at the annotathon.org website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

4th week:
Practical: Annotation of novel metagenomic sequences at the annotathon.org website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

5th week:
Practical: Annotation of novel metagenomic sequences at the annotathon.org website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

6th week:
Practical: Annotation of novel metagenomic sequences at the annotathon.org website. Identification of open reading frames, calculation of protein MW. Searching for protein domains in the INTERPRO database. Searching for similar proteins with BLAST, taxonomy classification based on the BLAST results and the phylogenetic tree.

15th week:
Lecture: Structural bioinformatics

Requirements

Requirements for grade offer:
Students are required to attend the practicals. Only one absence is accepted from the practicals - in case of more absences students will not be offered a grade.
Grading: Grades will be offered based on the student's performance during the practicals, on a five-grade scale. The list of evaluation topics and the evaluation rules will be announced by the Department at the beginning of the semester.

Subject: **CELL AND ORGAN BIOCHEMISTRY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**
Practice: **15**

1st week:
Lecture: Cell proliferation I.

2nd week:
Lecture: Cell proliferation II./apoptosis
Practical: Polymerase chain reaction - basics of experimental design and optimization.

3rd week:
Lecture: Gene expression I.

4th week:
Lecture: Gene expression II.

5th week:
Lecture: Signaling I.

6th week:
Lecture: Signaling II.

7th week:
Lecture: Iron, haem
Self Control Test (Topics for week 1-6.)

8th week:
Lecture: Hgl, inflammation

9th week:
Lecture: Liver

10th week:
Lecture: Haemostasis I.

11th week:
Lecture: Haemostasis II.

12th week:
Lecture: Extracellular matrix

13th week:
Lecture: Stress
Self Control Test (Topics for week 7-12.)

14th week:
Lecture: Biochemistry of the sport

15th week:
Lecture: Summary, consultation.

Requirements

Content of Organ and Cell Biochemistry:
Topics presented at the lectures and discussed during the seminars (available at the

http://bmbi.med.unideb.hu web site, username and password are announced on the first lecture). At the weekly seminars the lectures of the previous week will be discussed with the seminar teacher.

Requirements for the written exam:
Participation in the seminars, and in the obligatory lectures. Only one absence is accepted from the obligatory lectures, and three absences are accepted from the seminars. In case of more absences students will not be permitted to take the written exam.

Self-control tests: (not obligatory) During the semester students may choose to write two self-control tests addressing the curriculum of the lectures and seminars. The self-control tests consist of single-choice and multiple-choice test questions, and by writing the both tests a total of maximum 40 points can be collected. If the combined score of the two tests is above 60% of the total score, bonus points can be awarded and added to the end-of-semester exam test score. Students can also be awarded 3 or 6 bonus points based on their performance during the seminars. The bonus points can be added to the points collected from the self-control testes, if the combined score of the two tests is above 60% of the total score.

Grading:
Grades will be offered based on the written examination during the exam period. The written exams consist of single-choice and multiple-choice test questions - a maximum of 100 points can be collected. If the exam test score is 60 points or above, bonus points earned during the semester can also be added to it. The student's performance will be assessed on a five-grade scale. Pass (grade 2): 60-69,5 points; satisfactory (grade 3): 70-79,5 points; good (grade 4): 80-89,5 points; excellent (grade 5): 90-100 points. Students may take one improvement exam per exam period. Students must register for the exams on the NEPTUN until the end of the 15th week.
Please follow the announcements of the department on the announcement table (LSB downstairs 1st corridor), and on the website (http://bmbi.med.unideb.hu)

Department of Botany

Subject: **PLANT MOLECULAR BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Seminar: **30**

1st week:
Lecture: Introduction into signal perception and transduction in plants. Role of developmental and environmental factors in gene expression in plants dispersion.
Seminar: Discussion of lecture topics.

2nd week:
Lecture: Plant DNA, nuclear genome structure. Properties and role of chloroplast and mitochondria genome organization in plants. Control of plant gene expression, basic features of light-dependent gene expression. Concept of transgenic plants and their application in plant biotechnology.
Seminar: Discussion of case studies.

3rd week:
Lecture: Gene expression in plant nucleus, chloroplast and mitochondria. Process and regulation of plant transcription. Plant RNAs: structure and function. Splicing mechanism of

RNA.
Seminar: Discussion of case studies. Discussion of lecture topics.

4th week:
Lecture: Protein synthesis, metabolism in plant cells. Concept and process of post-transcriptional regulation in plants. Specific plant proteins. Mechanism and features of plant protein degradation and transport.
Seminar: Discussion of case studies.

5th week:
Lecture: Relationship of programmed cell death and development (differentation), senescence progression and stress-related events in plant cells.
Seminar: Discussion of lecture topics. Case studies.

6th week:
Lecture: The organization of plant cell cytoskeleton and its function in regulating plant cell shape, morphogenesis, cell division. Regulation of plant cell cycle. The structure and function of plant cell membranes.
Seminar: Discussion of lecture topics. Methods in studying cytoskeleton and cell cycle regulation in plant cells.

7th week:
Lecture: Molecular biology of plant growth regulators: auxins, cytokinins- functions, transport, signal transduction pathways, regulation of gene expression.
Seminar: Discussion of lecture topics. Methods of studying molecular biology of auxin and cytokinin action.Immunohistochemistry, live cell imaging, molecular biology methods.

8th week:
Lecture: Molecular biology of plant growth regulators: auxins, cytokinins- functions, transport, signal transduction pathways, regulation of gene expression.
Seminar: Discussion of lecture topics. Methods of studying molecular biology of auxin and cytokinin action.

9th week:
Lecture: Molecular biology of plant growth regulators: gibberellic acids (GAs), abscisic acid (ABA), ethylene, brassinosteroids, salycilic acid, jasmonic acid - functions, signal transduction pathways, regulation of gene expression.
Seminar: Discussion of lecture topics. Methods of studying molecular biology of GA, ABA, ethylene action.

10th week:
Lecture: Plant life cycle and molecular regulation of plant morphogenesis; photoreceptors and light-regulated gene expression.
Seminar: Discussion of lecture topics. Case studies.

11th week:
Lecture: Photosynthesis and its regulation. Proteins in photosynthetic electron transport chain; Responses of plants to different light conditions (intensity, wavelength, duration) and changes in other environmental factors; regulation of carbohydrate metabolism.
Seminar: Discussion of lecture topics. Methods of studying photochemical activity and carbon assimilation pathways.

12th week:
Lecture: Responses to abiotic stresses; basic mechanisms underlying adaptation processes necessary for withstanding unfavourable growth conditions; stress signal transduction and physiological reactions.
Seminar: Discussion of lecture topics. Case studies

13th week:
Lecture: Secunder metabolic pathways in plants. Terpenoids, alkaloids, phenoloids and polykhetides.
Seminar: Discussion of lecture topics.

14th week:
Lecture: Function, allelopathy and bioactivity of secondary metabolites in plants.
Seminar: Discussion of lecture topics. Case studies.

15th week:
Lecture: final exam

Requirements

The program consists of lectures, seminars and laboratory practices. Attendance at seminars is recorded. Students should attend at least 80% of seminars.

Textbook:
Plant Biology Manual, Department of Botany. Material is published on the botany.ttk.unideb.hu web page.

Subject: **PROBLEM-SOLVING EXERCISES IN MOLECULAR BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **45**

Requirements

Aim of the course (partial/complete skills and competencies):

The aim of the course is to give differentiated professional knowledge about a selected area of molecular biology. All departments involved in molecular biology education are entitled to announce exercises. The extensive collaboration offers possibility for students to encounter the present day problems and questions of molecular biology and search for the answers. Students can join to the current research projects and learn the independent laboratory work. This prepares them for their future work as a PhD or research group leader, which requires problem solving thinking and enables them to find the correct answers.
By acquiring the course material students will get a more in-depth knowledge of the related literature, will become able to solve problems using the method and summarize the results in a comprehensible form.

Topics:
The project is the elaboration of an exercise that can be solved using molecular biological methods. The student gathers the possible methods leading to the solution (reading the literature) and suggests a solution with the method he believes the best. The student designs and performs the experiments and analyzes the data with the help of the supervisor. Students must summarize their work in a written report of 8-10 pages.

Recommended literature:
Related to the projects, offered by the tutors

Department of Medical Chemistry

Subject: **METHODS IN MOLECULAR BIOLOGY PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **45**

1st week:
Practical: Preparation of genomic DNA, PCR, agarose gel electrophoresis. Preparation and assay of total RNA, RT-PCR, Q-PCR. Cultivation of bacterial and eukaryotic cells. Preparation and transformation of competent E. coli cells, DNA cloning.

2nd week:
Practical: Extraction of proteins. SDS-PAGE, Western blotting. Expression and affinity chromatographic purification of GFP. Preparation and restriction mapping of plasmid DNA. ELISA. Immunocytochemical analysis.

Requirements

During an intensive practical course the students learn how to execute molecular biology experiments, utilize the methods for solving practical questions as well as understand the limitations and power of the molecular biology approaches. The program consists of laboratory practices concentrated in the first two weeks of the semester. Attendance on laboratory practices is obligatory and will be recorded. The successful completion of all practical experiments, including the proper discussion of the results, is a strict requirement that will be checked based of the students' notebook by the lab instructors. Missed experiments may be made up in an extracurricular time with the instructor. In the absence of a notebook signed by all of the lab instructors the subject will not be accepted. The complete and duly signed notebook has to be submitted to the course coordinator before the start of the examination period. The work of the students will be evaluated based on the written notes of the student in the notebook. The point is that all of the experiments should be described so that it would be possible to reproduce it by a graduated molecular biologist.

Department of Medical Microbiology

Subject: **PHYSIOLOGY OF PROKARYOTES, MOLECULAR VIROLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**
Practical: **15**

1st week:
Lecture: History of virology. Structure and taxonomy of viruses.

2nd week:
Lecture: Virus replication.

3rd week:
Lecture: Replication strategies of viruses.

4th week:
Lecture: Pathogenesis of viral infections. Virus-host interactions. Tumour viruses.

5th week:
Lecture: Host defense against viral infections. Evasion of immune responses by viruses.

6th week:
Lecture: Immunization. Vaccine types. Antiviral treatment.

7th week:
Lecture: Subviral agents. Prions.

8th week:
Lecture: Bacterial cell structure. Propagation of bacteria.
Practical: 8th week 1st day: Propagation of bacteria. Macroscopic, microscopic morphology. Demonstration: Bacteria on solid media Staphylococcus aureus NA, BAα-haemolytic Streptococcus BA, ChABacillus subtilis NA, BAEscherichia coli NA, EMBKlebsiella p. NA,

EMBProteus mirabilis NA, EMBPseudomonas aeruginosa NA, EMB2. Stained smears. Working task: 1. Preparing smear from bacterial cultures. Gram staining of smears. (Staphylococcus aureus, Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa) 2. Preparing hanging drop to study motility of bacteria (Bacillus subtilis, Klebsiella sp., Escherichia coli, Pseudomonas aeruginosa) 8th week 2nd day: Biochemical tests. Demonstration: a. MR (methyl-red reaction): E. coli, Klebsiella sp.b. VP (Voges-Proskauer reaction): E. coli, Klebsiella sp.c. Esculin hydrolisis (BEA medium): Enterococcus faecalisd. indol test: E. coli, Klebsiella sp.e. ureum hydrolisis test: E. coli, Klebsiella sp.f. phenylalanin-deaminase test: Proteus sp., E. colig. Oxidase reaction: Pseudomonas sp., E. colih. Catalse test: S. aureus, E. faecalisi. Coagulase test: S. aureus, S. epidermidis Working task: 1. MR (methyl-red reaction): E. coli, Klebsiella sp. 2. VP (Voges-Proskauer reaction): E. coli, Klebsiella sp. 3. indol test: E. coli, Klebsiella sp. 4. Oxidase reaction: Pseudomonas sp., E. coli 5. Catalse test: S. aureus, E. faecalis 6. Coagulase test: S. aureus, S. Epidermidis 7. Calturing of bacteria (E. coli) for antibiotic sensitivity test8th week 3rd day: Antibiotic sensitivity tests. Serological reactions. Demonstration: ELISA, Western-blot. Working task: VDRLSlide agglutination (Escherichia coli)Validation and interpretation of ELISA, Western-blotEvaluation of antibiotic sensitivity test.

9th week:
Lecture: Photosynthesis of bacteria. Chemolithotrophic bacteria. Bacterial catabolism. Archea.
Practical: 9th week 1st day: Working task: Inoculation of embrionated egg with Newcastle disease virus (NDV)9th week 2nd day: Working task: Harvesting and freezing the chorioallantoic fluid (virus solution) from the infected embrionated eggs. 9th week 3rd day: Demonstration: Haemagglutination inhibition. Working task: Haemagglutination with the previously harvested and frozen virus solution. Calculation the haemagglutination titer. Immunofluorescence staining: human cytomegalovirus antigenaemia for pp65 antigen.

10th week:
Lecture: Bacterial DNA replication. Regulation of gene expression in prokaryotes.

11th week:
Lecture: Plasmids, transformation of bacteria.

12th week:
Lecture: Pathogenicity, virulence. Host defense against bacterial infections. Immunization.

13th week:
Lecture: Sterilization, disinfection

14th week:
Lecture: Antibacterial therapy

15th week:
Lecture: Consultation

Requirements

The program consists of lectures and laboratory practices. Attendance at laboratory practices and lectures is recorded. Students should attend 100% of laboratory practices. In exceptional cases, the student may make up one missed practice after consultation with the lab teacher. Students should prepare a laboratory notebook which is collected at the end of the practices. From the 2nd week at the beginning of the lecture a short (10-15 min) test is written during the whole semester. Test contains questions about the materials from the previous lecture and the actual practice. Based on the cumulative results of the tests, students are offered an End-Semester-Examination (ESE) grade. Those who are not satisfied with the offered grade or are bellow the passing level, should take an end- semester-examination (A –chance) hold in the examination period. The student's test will be assessed on a five-grade scale. The written examination (A and B chance) consists of assay questions. C-chance is a written examination and in case of failed result the student has to take an

oral examination. The examination rules will be announced during the semester.

Topics:
Replication and propagation of bacteria; prokaryotic energy metabolism; regulation of gene expression in prokaryotes; pathogenicity, virulence; host defense against bacterial infections; immunization; sterilization, disinfection; antibacterial therapy; plasmids, transformation of bacteria
Replication of viruses; viral pathogenesis; host defense against viral infections, immunization; oncogenic viruses; antiviral agents; prions;

Department of Physiology

Subject: **HUMAN PHYSIOLOGY II.**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Principles in renal physiology. The nephron. Quantitative description.

2nd week:
Lecture: Glomerular filtration and tubular transports.

3rd week:
Lecture: Osmoregulation, water balance. Control of body fluid volume.

4th week:
Lecture: Regulation of acid-base balance.

5th week:
Lecture: General principles of endocrinology.

6th week:
Lecture: The thyroid gland.

7th week:
Lecture: The hormones of adrenal cortex.

8th week:
Lecture: The hormones of adrenal medulla.

9th week:
Lecture: General principles in the regulation of gonadal functions. Male and female gonadal functions.

10th week:
Lecture: Ca-homeostasis.

11th week:
Lecture: Regulation of blood glucose level.

12th week:
Lecture: Cellular neurophysiology.

13th week:
Lecture: The sensory system. Physiology of hearing, taste and smell sensation.

14th week:
Lecture: Physiology of the vision.

15th week:
Lecture: Control of movements. Vestibular system.

Requirements

1. Signature of Lecture Book
Attendance of lectures is compulsory. If one has more than 2 lecture absences, the end-semester

examination (ESE) may not be substituted with the average test score (see later). For continuous updates on all education-related matters, please check the departmental web-site (http://PHYS.MED.UNIDEB.HU).

2. Evaluation during the semester (mid-semester tests)
The knowledge of students will be tested 3 times per semester in the form of a written test (multiple choice questions). Participation on mid-semester written tests is compulsory.

3. Examination
The semester is closed by an an end-semester exam (ESE) covering the topics of all lectures of the semester. The A and B chances of the end-semester exams are written tests (multiple choice questions), while the C chance is an oral exam. The grade of the written test is calculated according to the following table:

Scoremark	
0 – 59.9 %:	fail
60 – 69.9 %	pass
70 – 79.9 %	satisfactory
80 – 89.9 %	good
90 – 100 %	excellent

ESE grade based on the average score of mid-semester tests will be offered if one's average score of the three mid-semester tests is above 60% and none of the individual tests' results are less than 40%. and (s)he has fewer than 3 lecture absences (see the table above).
- If one is not satisfied with the offered grade, (s)he may participate in ESE during the examination period. In his case the previously offered grade is cancelled.

Subject: **HUMAN PHYSIOLOGY PRACTICALS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **30**

1st week:
Practical: Investigation of the cardiovascular functions.

2nd week:
Practical: Determination of parameters characterising the respiratory functions.

3rd week:
Practical: Examination of the blood.

4th week:
Practical: Computer aided aquisition and processing of biological signals.

5th week:
Practical: Effects of electrolytes on the uterinal smooth muscle function.

6th week:
Practical: Effects of neurotransmitters and hormones on the uterinal smooth muscle function.

7th week:
Practical: Computer simulation of the frank-straling-mechanism.

8th week:
Practical: Simulation of the renal transport mechanisms.

9th week:
Practical: Computer simulation of the glucose tolerance test.

10th week:
Practical: Remedial lab.

11th week:
Practical: Closing lab.

Requirements

1. Signature of Lecture Book
Attendance of laboratory practices is compulsory. The signature of the Lecture Book may be refused for the semester in case of more than two absences from the practices. All missed practices must be made up. Completion of all topic sheets in the Exercise Book, each verified by the signature of the teacher, is also a precondition of the signature of the Lecture Book.
The schedule of laboratory practices and continuous updates on all education-related maters are published on the departmental web-site (http://PHYS.MED.UNIDEB.HU).

2. Evaluation during the semester
Laboratory practical knowledge of the students will be tested at the end of the semester as part of the Closing Lab, evaluation with five level grades. As a precondition of attending the Closing Lab, the fully completed Exercise Book (with all the verified topics) must be presented during the Closing Lab. Students are expected to perform the given experiment on their own and must also be familiar with theoretical background. In case of a negative result, the Closing Lab can be repeated, but only once before the beginning of the exam period.

Division of Biomathematics

Subject: **BIOSTATISTICS**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**

7th week:
Lecture: Biostatistics. Probability theory. Set theory. Random events. Conditional probability, marginalization. Independent events.

8th week:
Lecture: Biostatistics. Random variable. Cummulative distribution function, distribution function of random variable. Mean, standard deviation.

9th week:
Lecture: Biostatistics. Discrete probability distributions: binomial and Poisson-distribution.

10th week:
Lecture: Biostatistics. Continuous probability distribution. Normal distribution. Standard normal distribution. Sampling.

11th week:
Lecture: Biostatistics. Hypothesis testing. Null hypothesis. Statistical significance. z-test.

12th week:
Lecture: Biostatistics. Paired, unpaired t-test, F-test.

13th week:
Lecture: Consultation.

Biostatistics final test.

Requirements

1. The aim of the course
To give an introduction to biostatistical methods, which can be used in different branches of medicine to solve biostatistical problems and to evaluate experimental results. In addition to providing a solid theoretical foundation the course will also introduce the students to the art and science of performing the simplest calculations.

2. Short description of the subject
Brief introduction to the most basic concepts of calculus (slope, fitting, area under the curve); counting techniques; descriptive statistics; algebra of events; probability; random variables; statistical distributions and their properties; binomial, Poisson and normal distributions; sampling techniques and characterization of samples; statistical test (z, t, F tests)

3. Requirements for the Biostatistics course
Attendance to classes is mandatory. Students must not miss more than 1 class. No kind of certificate, including a medical certificate, is accepted for the absences. Making up for missed classes is not possible. All material covered in lectures is an integral part of the subject and therefore included in the final exam. In the classes, students are encouraged to ask questions related to the topic of the lectures discussed (see timetable of lectures and seminars).
4. Requirements for signing the lecture book:
Signing of the lecture book is denied if there are more than 1 absences from groupwise classes.

5. Course test and final exam:
Students must take a written exam. Students will write a grade-offering course test after the last seminar. The structure of this test will be identical to that of the final exam: it contains theoretical questions (true or false questions, multiple choice question, fill-in questions, open-ended questions) and calculations. A maximum 100 points can be obtained in the test. Based on the final score of the exam the following grades are offered:

- FS<50 fail
- 50=<FS<65 pass
- 65=<FS<75 satisfactory
- 75=<FS<85 good
- 85>=FS excellent

Exams will be held once every two weeks during the exam period. A grade of 2 or better achieved on the grade-offering test is valid for the final exam.

6. Obligatory reading
Educational material published on the web page of the Department which can be downloaded in pdf format (web page: biophys.med.unideb.hu)
7. Compulsory reading
Wayne W. Daniel: Biostatistics, A foundation for Analysis in the Health Sciences, John Wiley&Sons

8. Exemptions:
Applications for exemption from the biostatistics course has to be turned in to the Credit Transfer Committee. Such requests are not accepted by the Biomathematics Division or the Department of

Biophysics and Cell Biology.

9. Information for repeaters
For repeaters the attendance to seminars is not compulsory. According to the relevant rules self-control tests may be written and exemptions may be obtained again

10. Rules for C-chance exams
If the result of the written part of a C-chance exam is at least a pass (2) according to the rules pertaining to A- and B-chance exams, the grade of the C-chance exam will be what is to be offered based on the rules of the A- and B-chance exams.. If the result of a C-chance exam is a fail, the written part will be followed by an oral exam. In this case the grade of the C-chance exam will be determined by the result of the written test and the performance on the oral exam.

Division of Cell Biology

Subject: **CELL BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Lecture 1: Introduction.
Lecture 2: Cell membrane. Membrane transport

2nd week:
Lecture: Lecture 1: ABC transporters and related diseases
Lecture 2:Ion channels, membrane potential

3rd week:
Lecture: Lecture 1: Calcium homeostasis
Lecture 2: Osmo-, volume and pH regulation

4th week:
Lecture: Lecture 1: Cellular organelles. Trafficking between cellular organelles, overview.
Lecture 2: Intracellular membrane systems I: lysosome, peroxisome, endoplasmic reticulum.

5th week:
Lecture: Lecture 1: Intracellular membrane systems II: The Golgi complex, endo- and exocytosis, protein sorting.
Lecture 2: The nuclear envelope. Transport through the nuclear pores

6th week:
Lecture: Lecture 1: The nucleus
Lecture 2: Structure of chromtatin

7th week:
Lecture: Lecture 1: Cytoskeleton I: microtubules.
Lecture 2: Cytoskeleton II: intermedier filaments, actin cytoskeleton.

8th week:
Lecture: Lecture 1:Cell energetics/mitochondrion.
Lecture 2: Cell-cell contacts, cell-extracellular matrix contacts.

9th week:
Lecture: Lecture 1: Cell signaling I. General concepts. Nuclear receptors. G-protein coupled receptors.
Lecture 2: Cell signaling II. Receptor tyrosine kinases. The Ras/MAPK, PI3K/Akt and PLC/CaMK pathways.

10th week:
Lecture: Lecture 1: Cell signaling III. Pathways to the nucleus. Oncogenes in signaling.
Lecture 2: Cell signaling IV. Cell-cell

communication in the nervous and immune systems.

11th week:
Lecture: Lecture 1: Mitosis, meiosis. Experimental systems for studying the cell cycle.
Lecture 2: Mechanics of mitotic cell division

12th week:
Lecture: Lecture 1: Regulation of the mitotic cell division.
Lecture 2: Cell fates I: Overview / differentiation.

13th week:
Lecture: Lecture 1: Cell fates II: Stem cells.
Lecture 2: Cell fates III: Cell senescence, apoptosis.

14th week:
Lecture: Lecture 1: Cell fates IV: Tumor cell biology.
Lecture 2: Cells in broader context: Interactions with drugs, viruses and bacteria.

15th week:
Lecture: Lecture 1: Cellular motility.
Lecture 2: Main features of the prokaryotic and eukaryotic cells: an overview.

Requirements

Lectures:
Attendance of lectures is highly indispensable for acquiring the knowledge required to pass! They are your best source of synthesized and structured information. Some new concepts are discussed exclusively at the lectures. To further facilitate attendance, an attendance bonus system was introduced also in the case of Cell Biology lectures: If a student is present in every lecture, he/she automatically receives 5 bonus points which is added to the result of the final exam score. Attendance will be checked randomly. The student will lose all these (5) bonus points, if he/she is caught missing any one of the lectures at these random checkings OR proves completely ignorant about the subject of the particular lecture, based on questions to be answered orally or in written. Certificates of any kind, including a medical certificate, will NOT be considered.

Books to be studied:
4th ed. of Essential Cell Biology (Alberts et al.,Garland Publ Inc. 2014. ISBN: 978-0-8153-4454-4) is the course book recommended as a foundation. It is concise, easy to read and the thorough knowledge of the material contained in its chapters (1. and 11-20.) is absolutely necessary for passing at the Final Exam. The preceding chapters contain explanations for basic molecular concepts: these chapters serve as reference and will not be directly asked in tests, except for certain parts indicated by the lecturer and also published in our website. In addition, there is a lot of additional information presented at lectures, and also discussed in the seminars, which the students are also required to know. The slides presented in lectures will be provided at the department website; however, you must attend the lectures and take notes to be able to interpret them. To read a full-text version of this additional material we recommend two books: Molecular Cell Biology (Lodish et al.) and Molecular Biology of the Cell (Alberts et al.)

Seminars:
In the seminars, students may ask their questions related to the topic of the lectures discussed (see final timetable of lectures and seminars that will be announced on the week 1. of the semester). Attendance of seminars is not compulsory. Students actively participating the seminars can give a short presentation on the topic of one of the lectures discussed in the seminar. The topics will be distributed in the first seminar or later can be asked from the educational manager. The talks are graded on a scale of 0-5.

Self-control Tests (SCT-s):
There are two SCT-s. The dates and topics for SCT-s will be announced on week 1 of the semester. Exact times and locations for each group will be posted during the semester. Types of the SCT questions are akin to the Final Exam questions; i.e. true or false, simple selection, multiple selection, relation analysis, fill in questions or define a definition type questions may be awaited. Lab questions will be included in the 2nd self-control test as well as in the Final Exam test, to approximately 10% of the total points. Based on the score of the SCT-s, you receive bonus points that count towards your grade in the Final Exam.

Conversion of SCT points into bonus points for Final Exam:
Bonus points based on the score (as a %) of an SCT. The bonus points are calculated as 0,05 x score (as a %). Maximum 5 bonus points can be earned with each SCT, so totally 10. Writing the SCT-s is highly recommended. If you miss a SCT, you will miss valuable points from your Final Exam score!

Grade offering based on SCT results:
For those performing well on SCT-s, i.e. earning 50 % or more in the average of the two SCT-s, based on the sum of their bonus points (lab points + lecture bonus + short presentation) and average SCT result we offer final grades as follows:

60-69.5 points:	pass (2)
70-79.5 points:	satisfactory (3)
80-89.5 points:	good (4)
above 90 points:	excellent (5)

The offered grades will be posted on the Neptun system where students must declare acceptance or refusal. Accepting the grade means exemption from the final exam, so the accepted grade will be entered into the lecture book as the final grade. Students without offered grade must attend the Final Exam (see below). If a student did not accept the offered grade, but his/ her average of the two SCT-s is 60 % or more, he/she does not have to write A-part of the written Final Exam (see later). They got 14 points.

Requirements for signing the lecture book:
No

Final Exam: The exam is a written test of two parts (A and B).

Part A:
Part A of the written test is a set of 10 questions addressing the basic concepts listed among the key-words published in our website. These questions will include 5 brief descriptions of basic concepts, and 5 questions of yes/no type. The descriptions should contain 2 valuable and relevant facts/statements on the subject asked, for maximal score (2 points each; partial points may be considered). The A test has to be completed in 10 minutes. You will need to collect at least 14 points to pass the A test. Those earning below 14 points in part A fail the entire exam without regard to their score on part B, what will not be corrected and scored in this case. The score of a passed A test will be added to the score of part B, thus yielding 14-20% of the total exam points.

Part B:

Part B is a complex test, including two short essays (2x10=20%), fill-in, short answer, multiple choice, relation analysis, sketch-recognition as well as simple choice and yes/no questions (50%). It contains material from the textbook, lectures and seminars. The lab questions are a section of the part B exam (to approximately 10% of the total test points).

Cell Biology part A written max. 20 points
Cell Biology part B written max. 80 points

Bonus points will be added only if the score of A+B part alone is above 50%:
Cell Biology short presentation bonus max. 5 points
Bonus points for lecture attendance max. 5 points
Bonus points based on SCT scores max. 10 points
Total 120 points

Your grade on the Final Exam:

below 60% points:	fail (1)
60-69.5% points:	pass (2)
70-79.5% points:	satisfactory (3)
80-89.5% points	good (4)
above 90% points	excellent (5)

Repeated exams:
On repeated exams during the exam period of the 2nd semester, points earned from SCT-s, lecture attendance and from short presentations are valid throughout. However, all bonuses and merits expire by next spring exam period. Note that all parts have to be repeated on repeated exams, that is, cell biology written part B (including the lab questions), and cell biology written part A with less than 14 points.
The test/exam grade earned should reflect the true knowledge of the student. Therefore, if there are doubts whether the result of the written tests (SCTs, A, B, exam) really reflect the true knowledge of the student, the teachers/professors may also ask oral questions so as to be able to give a grade they deem justified.
The C chance exam always starts with a written part (similarly to A and B chance exams) and if the student fails on the written part, it is followed by an oral exam in front of a committee. The committee summarizes the results of both parts and decides the grade, not necessarily averaging them.

Exemptions:
In order to get full exemption from the cell biology course the student has to write an application to the Educational Office. The Department of Biophysics and Cell Biology does not accept such applications. Applications for exemptions from part of the courses are handled by the department. The deadline for such applications is Monday on the second week. The following documents have to be submitted to the study adviser: 1. application with an explanation why the student thinks that he/she is eligible for an exemption; 2. certificates about the courses the student has taken; 3. a reliable description of the curriculum of the courses taken. The decision about exemption is based on a result of an "open-book"' exam test on the third week. Applicants will be notified whether they have to take such an examination.

Further Information:

* Study advisor from Cell Biology: Zsolt Fazekas Ph.D. (cellbioedu@med.unideb.hu)
* Info regarding tests, seminars, lectures is posted on the lab door ("Biophysics lab", ground floor, Theoretical Building), the department bulletin board and http://biophys.med.unideb.hu.
User names and passwords will be given out at the first cell biology seminar during the first week of the semester.
* We offer to keep an e-mail contact with the students whenever possible. This is smooth, fast and effective. Please write to cellbioedu@med.unideb.hu.
* Personal consultation with the study advisor: office hours are posted on the web site and the bulletin board of the Department. For appointments outside office hours please write an email.

Recommended books accessible online free of charge can be reached at the following URLs:
Lodish et al.: MOLECULAR CELL BIOLOGY (4th ed.):
http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mcb
Alberts et al.: MOLECULAR BIOLOGY OF THE CELL (4th ed.):
http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=mboc4
Every online book can be searched electronically for keywords.

CHAPTER 11
REQUIRED ELECTIVE COURSES

Department of Biochemistry and Molecular Biology

Subject: **GENOMIC BIOINFORMATICS**
Year, Semester:
Number of teaching hours:
Lecture: **15**
Practical: **30**

1st week:
Lecture: Molecular databases, primary sequence databases (EMBL, GenBank. Analysis of scientific publications.

Practical: Introduction to UNIX. Downloading from databases, analysis witn command line methods. Simple statistical analysis with UNIX commands.

2nd week:
Lecture: Similarity search methods. The BLAST program. Journal club. E

Practical: Usage of local command line BLAST programs. Database download, generating local BLAST databases. Different types of local BLAST searches, analysis of results.

3rd week:
Lecture: Theory and application of microarray technology. Journal club.

Practical: Downloading microarray data from the GEO and ArrayExpress databases. Analysis of raw microarray data with the Chipster program.

4th week:
Lecture: Alignment methods for short reads generated by next generation sequencing. De novo genome assembly, Velvet and SOAP methods. Journal Club.

Practical: Downloading next generation sequencing data from the SRA and ENA databases. Alignement to reference genome with BWA and Bowtie, using the supercomputer. De novo genome assembly with Velvet and SOAP methods using the supercomputer.

5th week:
Lecture:
The ChIP-seq method. Journal Club.

Practical: Analysis of a ChIP-seq experiment on a local computer: from downloading the raw data to de novo motif finding

6th week:
Lecture:
RNA-seq, TSS-seq and TSS-exon-seq methods. Journal club.

Practical: Downloading and analysis of RNA-seq and TSS-seq raw data on local computer.

7th week:
Lecture:
The GWAS method. Understanding the causes of genetic disorders using SNP data.

Practical: Downloading and analysis of GWAS data

Requirements

During this interactive course students will learn about genomics technologies through key publications. We will discuss the most important primary databases, the usage of BLAST and other similarity searching programs, the genome sequencing approaches and technologies, the microarray methods and the next generation sequencing applications. For the practicals students will have access to a local UNIX server, will download and analyze publicly available data with command line programming.
Lecture attendance and active participation in the practicals is required.

Subject: **MOLECULAR MECHANISM OF DISEASES CONCERNING GREAT POPULATIONS**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **25**

1st week:
Lecture: Introduction to molecular medicine

2nd week:
Lecture: Genomic medicine

3rd week:
Lecture: Diabetes

4th week:
Lecture: Obesity

5th week:
Lecture: Vitamin D and immundefects

6th week:
Lecture: Cancer I.

7th week:
Lecture: Cancer II.

8th week:
Lecture: Cancer II.

9th week:
Lecture: Osteoporosis

10th week:
Lecture: Immunedeficiencies

Requirements

Course content: topics presented at the lectures (available at the website of the Department of Biochemistry and Molecular Biology,**)**
Follow the link: Downloads - Education in English - Elective courses

Attendance:
Students are expected and required to attend all lectures of this course. No more than one unexcused absence is permitted. Students will fail the course on their second unexcused absence. Legitimate excuses should be presented in writing to the course administrator by the specified date.

Grading policy:
The final grade will be based on the final oral exam at the end of the semester. Students have to select one topic from the full list of course topics for their oral exam, and can sign up for the topic at the link below. The final sign-up sheet will be posted on the department web-site at the beginning of the exam period. **It will be your responsibility to contact the lecturer for the assignment, and**

for the date of the oral examination. The course lecturers will assign scientific publications to the students based on the sign-up sheet. For the oral exam students are expected to prepare a short Powerpoint presentation (4-5 slides) based on the publication, and discuss the publication with the lecturer.

Please follow the **announcements** of the course administrator about exam dates or changes in the schedule on the bulletin board (LSB downstairs, 1 corridor), and on the department

Subject: **PROTEOMICS**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**
Practical: **30**

1st week:
Lecture: Introduction to proteomics. Proteins: characterization, production, analysis, therapeutical uses.

2nd week:
Lecture: The role of proteomics in modern medicine

3rd week:
Lecture: The basics of mass spectrometry

4th week:
Lecture: Protein sequencing

5th week:
Lecture: Databases for proteomics

6th week:
Lecture: Purification of proteins

7th week:
Lecture: Analysis of proteins

8th week:
Lecture: Analysis of protein-protein interactions

9th week:
Lecture: Identification of biomarkers by mass spectrometry. Targeted validation of biomarkers by proteomics.

10th week:
Lecture: Analysis and characterization of protein structure. Identification of post-translational modifications.

11th week:
Lecture: Quantifying proteins. Quantitative proteomics.

12th week:
Lecture: Production and utilization of therapeutical proteins.

13th week:
Practical: Transformation of competent cells with plasmid vector. Production of recombinant proteins - an overview. Vector selection, construction of a restriction map with NEB Cutter. Selection of host system. Vector preparation, primer design (basics and hands-on excercise) with the Quick Change software.

14th week:
Practical: Bacterial culture and induction with IPTG. Mass spectrometry - demonstration. Introduction to the Voyager DEPRO MALDI-TOF (Applied Biosystems) and Agilent 1100 HPLC-linked 4000 QTRAP (Applied Biosystems) systems. Basics of mass spectrometry and data analysis.

15th week:
Practical: Protein purification from bacteria. Data analysis and interpretation.

Requirements

Aims:
The course enlarges the knowledge of the students making them able to work on the specific field of proteomics. They will be able to understand proteomics data, to design proteomics experiments and by acquiring practical knowledge, the students will be able to work in proteomics labs, to carry out proteomics experiments, to do innovative proteomics research and to continue their studies at PhD level.

Subject description:
During the course the students will get knowledge about the basics of proteomics, the gel- and mass spectrometry-based methods which make possible the identification and quantification of proteins and to detect the post-translational modifications. The practicals are in accordance with the lecture materials and the students can learn in practice the most important and critical steps of sample preparation and the major criteria of data analysis.

Schedule of the lectures:
Introduction to proteomics – Why do we need proteomics? What kind of data proteomics can and cannot provide?

- Basics of liquid chromatography
- Basics of mass spectrometry
- Protein identification using mass spectrometry. Peptide sequencing, data interpretation
- Targeted proteomics (SRM/MRM, PRM), data dependent and data independent analysis (DDA, DIA)
- Quantitative proteomics (iTRAQ, SILAC, label-free quantification, SRM, PRM)
- Detection of post-translational modifications using mass spectrometry. Sample preparation strategies, specific enrichment
- Two dimensional electrophoresis
- Proteobioinformatics
- Protein purification strategies
- The study of protein-protein interactions
- Biomarker identification and validation using mass spectrometry
- Preparation and use of protein therapeutic agents. The role of mass spectrometry in quality control
- Consultation

Practice:
On three consecutive days at the end of the semester.

Day 1: 10 hours
4 hours: SDS-PAGE separation of protein mixtures. Gel staining with Coomassie dye.
1 hour: Scanning of Coomassie stained gels.
5 hours: Excising and destaining of gel bands, in-gel trypsin digestion.

Day 2: 10 hours
3 hours: Extracting the digested peptides from the gels.
6 hours: In-solution trypsin digestion of protein mixtures.
1 hour: Desalting of in-solution digested samples with C18 resin-containing tips

Day 3: 10 hours
3 hours: Mass spectrometry (demonstration).
Introduction to mass spectrometers located in the Proteomics Core Facility. Demonstration of sample injection techniques.
3 hours: Mass spectrometry data analysis. Analysis of MS/MS data with the MASCOT search engine. Analysis of MS/MS data with the Protein Pilot software (demonstration). Basics of mass spectrometry data interpretation.
4 hours: Basics of SRM assay design. SRM data analysis with the Skyline software.

Subject: **STRUCTURE AND FUNCTION OF MACROMOLECULES**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**
Practical: **30**

1st week:
Lecture:
1-2. Theoretical approaches in biochemistry. Principles of protein folding. Evolution of proteins.
Practical:
1. Introduction to the Pymol programme
Installation of Pymol, reading a PDBfile, selection, representation, determination the chain orientation, representation of the surface residues.

2nd week:
Lecture:
3-4. Basis of protein structure and design. Properties of amino acids. Analysis and design of secondary structures.
Practical:
2. Visualisation of molecules
Different representations, backbone display, determination ofconformational parameters of the peptide chain. Analysis of helical structures, orientation of helix dipoles, interaction between helices.

3rd week:
Lecture:
4-5. Interactions between secondary structures. Generation of different domain types. Structure databases.
Practical:
3. Supersecondary structures
Analysis of the Ramachandran map. Studying the ROP protein: orientation and interaction between secondary structures, the roles of heteroatoms. Analysis of tropomyosin repeats, analysis of coiled coils. Interaction pattern, origin of stability.

4th week:
Lecture:
6-7. Experimental techniques of structure determination and analysis. Structure-function relationships.
Practical:
4. Tertiary structures of proteins. All alpha structures
Searching for helical domains. The structure of myoglobin. Analysis of porphyrin structure. The structure of hemoglobin. Allosteric communication between the subunits. Potential pathways of oxigen binding. Comparative analysis of hemoglobin structures. Superposition of hemoglobin structures from different organisms.

5th week:
Lecture:
8-9. Prediction of tertiary protein structures. Homology modeling. Loop-design.
Practical:
5. Alpha/beta domain structures I
The structure of the alpha-amylase. Analysis of helix and strand topology. Localization of the active site. Representation of the ligand, analysis of ligand binding. Searching for enzymes with

similar structures. Evolutionary analysis of similar alpha/beta domain structures. Superposition of other domains.

6th week:
Lecture:
10-11. Structure of nucleic acids. DNA-protein interactions. DNA recognition motifs and structural elements.
Practical:
6. Alpha/beta domain structures II
The structure of flavodoxin. Secondary structure prediction for flavodoxin sequence and comparison with the observed structural elements. Analysis of beta strands in terms of localization, orientation and hydrogen bonding pattern. Studying the geometry of the connecting loop. Searching for similar structures, superposition.

7th week:
Lecture:
12-13. Enzymatic catalysis.
Practical:
7. All beta structures
Hydrogen bonding pattern and characteristic residues in parallel and anti-parallel beta strands. Analysis of retinol binding protein. Analysis and categorization of beta turns. The greek key motif, studying the gamma-crystallin structure. Analysis of the beta strands in the ErbB receptor.

8th week:
Lecture:
14-15. Experiment design. Docking, amino acid replacements. Interpretation of experiments.
Practical:
8. Transmembrane proteins
Analysis of the photosynthetic reaction center. Display of the different chains, selection of those, which are located in themembrane. Determination of the secondary structures, topology and membrane interactions. Determination of polar and apolar surfaces, and their positions wit respect to the membrane. Representation of chlorophyll molecules and their location with respect to secondary structures.

9th week:
Practical:
9. Analysis of transmembrane structures.
Prediction of G-protein coupled receptors. Prediction of transmembrane protein segments based on secondary structure predictions and analysis of hydrophobicity profiles. Analysis of pore forming proteins (Omp). Analysis of the inner and outer surface of the pore. Mutations affecting selectivity or stability. The strutcure of bacteriorhodopsin.

10th week:
Practical:
10. Pancrease lipase
Structural basis of the molecular mechanisms, which were introduced in biochemistry and molecular biology courses. Analysis of domain structure in free and ligand-bound forms. Interactions of the ligand binding loop with the domain interfaces and its movement during enzymatic activity. Interactions of the colipase.

11th week:
Practical:
11. Specificity of enzymes
Comparative analysis of trypsin and chymotrypsin. Superposition of structures. Analysis of active sites and substrate-binding pockets. Functional consequences of the different architectures. Specific and cross-docking of ligands. Active sites of aspartyl proteinases, potential catalytic mechanism.

12th week:
Practical:
12. DNA structures
A, B, Z DNA structures. Analysis of differences in the hydrogen bonding pattern and stacking interactions. Structural consequences of DNA lesions, analysis of a thymine dimer. The structure of the Holliday-junction and its biological role.

13th week:
Practical:
13. RNS structures.
Typical secondary structures in RNA. Localization of Mg ions and their interactions

with the different structural elements of RNA. Analysis of t-RNA szerkezetének structure. The structure of the ribozyme and basis of catalysis.

14th week:
Practical:
14. DNA - protein interactions.
Analysis of typical DNA recognition motifs: helix-turn-helix, leucin zipper, Zn-finger, Ig-fold. Distortion of DNA upon binding to TBP or CAP. DNA recognition by disordered proteins, the LEF-1 transcription factor.

15th week:
Practical:
15. Consultation, discussion of homeworks.

Requirements

Goals: Design and interpretation of the biochemical and molecular biology experiments. Insights into the structure and function of proteins and nucleic acids, using physical principles.
Short description: Understanding and design of biomolecular structures. Experimental and computational methods for structure determination of biomolecules. Theoretical approaches to biochemical problems. Rational experimental design. Discussion of scientific papers, participation in scientific debates.

Material:
Literature:
Stryer: Biochemistry; A. Warshel: Computer modeling of chemical reactions in enzymes and solutions; A. Leach: Molecular modelling

Requirements of signature:
Attendance of 80% of the lectures, 100% of practicals. Practical homeworks must be submitted and accepted.

Evalutaion during the semester:
Practical homeworks.
Evaluation at the end of the semester: oral exam

Subject: **THESIS I.**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Practical: **75**

Subject: **THESIS II.**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Practical: **150**

Subject: **THESIS III.**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Practical: **225**

Department of Evolutionary Zoology and Human Biology

Subject: **MOLECULAR BIOGEOGRAPHY AND PHYLOGEOGRAPHY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**
Seminar: **15**

Requirements

Aim of the course (partial/complete skills and competencies):
Outline of major geographical patterns and processes of biodiversity from molecular to ecosystem level; molecular methods of the survey of speciation processes in space and time illustrated by numerous recent case studies; the course substantiates further studies and practical works in Evolutionary and Conservation Biology.

Topics:
Geographical patterns of molecular and chromosomal variation, case studies; geographical patterns of polyploidy; "gene centres" of cultivated plants; molecular structure and dynamics of the geographical range, the "leading edge" and "rear edge"; evolutionary genetics of colonising (invasive) species; phylogenetic diversity within monophyletic groups (within and among species): "Evolutionarily Significant Units", case studies in the nature conservation; coevolution, processes and results in biodiversity; methods of molecular biogeography and phylogeography: combination of demographic and population genetic methodsfor reconstruction of the population genetic and dynamic parameters, the coalescence theory and models; construction of molecular biogeographical trees, case studies; methods of phylogeography and phylogenetic biogeography: reconstruction of Quaternary speciation in different groups of plants and animals, case studies in Europe and in the Pannonian region; the geographical history of the Biosphere: cycles and trends, mass extinctions and radiations; plate tectonics and phylogenetic explanation of vicariant patterns; Tertiary and Quaternary climatic changes and faunal migrations; glacial refugia and disjunctions; late-glacial and post-glacial faunal migrations and extinctions, the recent macro-structure of the Biosphere: zonobiomes and orobiomes; threatened species: Biogeography and Nature Conservation.

Department of Immunology

Subject: **BASIS OF CONVENTIONAL AND BIOLOGICAL IMMUNOTHERAPIES**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week: **Lecture:** Production of monoclonal antibodies.	Use of monoclonal antibodies in therapy. Use of polyclonal antibodies in therapy.

2nd week:
Lecture: Mechanisms of tumor development. Immune response to tumors. Tumor vaccines.

3rd week:
Lecture: Infection by Human immunodeficiency viruses (HIV). Therapies available for HIV positive patients.

4th week:
Lecture: Vaccination strategies.

5th week:
Lecture: Congenital immunodeficiencies I. Congenital immunodeficiencies II. Treatment of congenital immunodeficiencies. Somatic gene therapy in theory and practice.

6th week:
Lecture: Xeno-transplantation and blood transfusion. Special issues associated with bone marrow transplantation. A graft-versus-host (GVH) disease.

7th week:
Lecture: Lymphoid leukemias. Hodgkin and non-Hodgkin diseases. Type I hypersensitivity reactions. Therapies for allergic diseases. Type II hypersensitivity reactions. Possible therapies.

8th week:
Lecture: Pathomechanisms of autoimmune diseases.

9th week:
Lecture: Tissue and organ-specific autoimmune diseases. Systemic autoimmune diseases. Immunology of allogenic organ transplantation.

10th week:
Lecture: Consultation. Presentations.

Requirements

During the semester students have to present a scientific paper recently published in a peer-reviewed international journal in the field of immunology.
The selected collection of the scientific papers will be defined by the Course Coordinator and students have to choose only one paper from this collection to prepare the oral presentation based on the chosen scientific publication.

Instructions for the exam:
1. The student shall look for the Course Coordinator at the Department of Immunology to request a scientific paper.
2. The suitable examiner/teacher will be defined by the Course Coordinator according to the topic of the chosen paper.
3. Student has to prepare the presentation based on the article.
4. Student has to present his/her slides to the examiner in 10-20 minutes until the end of the Semester.

Form of the presentation:
- Power point slides (no limitation in the number of the slides or in the style of the slides).
- Please indicate the following information on the first slide: name, specialization, neptun code, title of the article, authors of the article, the name of the journal, the pages and the year of the publication.
- Stucture of the presentation: backgrounds, aims, methods, results and discussion or conclusion including the significances of the work.

Subject: **IMMUNOLOGICAL METHODS IN MOLECULAR BIOLOGY**
Year, Semester: 1st year/2nd semester
Number of teaching hours:
Lecture: **15**
Practical: **15**

3rd week:
Lecture: Antigens and antibodies. The antigen; The antibodies, its properties, functions, and usage in practice. Monoclonal and polyclonal antibodies. Hybridomes. Affinity purification of antibodies.

4th week:
Practical: Establishing antibody producing hybridome cells: Basics of hybridome fusion method; Cell cloning; Antigen specific polyclonal antibody purfication on affinity column; Basics of concentration quantification.

5th week:
Lecture: Secondary reactions of antigen-antibody interactions; Complement system; Macrophage functions. Serological reactions; Immuncomplexes; Precipitation; Agglutination; Immunodiffusion methods; Complement activation; Monitoring macrophage functions.

6th week:
Practical: Methods based on secondary reactions of antigen-antibody interactions; Precipitation, agglutination; Immunodiffusion; Complement activation; Examination of the macrophage effector functions: phagocytosis of opsonized and untreated yeast; Detection of the macrophages' NO production.

7th week:
Lecture: Methods based on primary antigen-antibody reactions 1. Principles of preparative and analytical methods based on antigen-antibody reactions; Describing immunocompetent cells by surface markers; Separation and functional examinations of the immunocompetent cells. Flow cytometry; Polyclonal lymphocyte activation; Blast transformation.

8th week:
Practical: Cell separation methods: adhesion and density based separation; Magnetic cell separation (MACS); Investigation of the homogeneity of the separated cell populations with cell surface markers by flow cytometry.

9th week:
Lecture: Immunoassay methods based on primary antigen-antibody reactions 2. Principles of preparative and analytical methods based on antigen-antibody reactions; Functional examinations of the immunocompetent cells; Cytokine detection; ELISA; Immunoblot methods; Immunohistochemistry; Fluorescent microscopy; ELISPOT; T-lymphocyte activation.

10th week:
Practical: 3 step indirect ELISA: measurement of antigen specific antibodies.

11th week:
Lecture: Methods from the frontiers of clinical immunology. Allergy and hypersensitivity reactions; Passive cutaneous anaphylaxis; Tissue typing (MHC typing); MHC multimers; Immunological high throughput screening methods; Bioassays.

Requirements

The lectures and the practices are thematically connected. The attendance is obligatory. As the 15 lectures are packed in 5 blocks, only one official (certificated) absence is allowed in the course. One official (certificated) absence is allowed also in the case of the practices, but the practice note of the missed practice should be prepared posteriorly as a making up.
As the topics of the practices and the lectures are connected, understanding of the practice topics

should be a prerequisite of a successful examination at the end of the semester. A written examination is performed at the first or second week after the final lecture. If this exam is failed (the score is below 50%) the grade can be obtained in the exam period by passing a quick written entry test and a subsequent oral test.
Attendants who passed their written exam but are discontent with their written exam grade, can participate on the oral exam in the exam period without the need for passing the quick written entry test. The grade obtained in this way can exceed the previous written test's grade but could also fall below it.
Pracise notes should be prepared after the practices. The practice note should be submitted to the practice leader before the next practice. The exact details and timing of the submission will be discussed with the practices leader on the first practice. The inadequately prepared practice note will be returned to the attendant by the practice leader for posterior correction. The result of the quick tests at the beginning of the practices and the practice notes is going to be evaluated together with the result of the self-control test.

Subject: **IMPAIRED SIGNAL TRANSDUCTION IN THE IMMUNE SYSTEM**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**

9th week:
Lecture: Monoclonal antibodies. Active and passive immunization. Infectious diseases, HIV.

10th week:
Lecture: Congenital immunodeficiencies I. (B-cell deficiencies). Congenital immunodeficiencies II. (T-cell deficiencies). Tumor immunology. Tumor antigens and immune response to tumors.

11th week:
Lecture: Escape mechanisms of tumors, suppression of anti-tumor responses. Approaches to overcome tumor-induced tolerance mechanisms. A hope for cancer immunotherapy.. Hypersensitivity reactions, Type I hypersensitivity (Allergy). Hypersensitivity reactions, Type II-IV hypersensitivity.

12th week:
Lecture: Mechanisms of the development of autoimmune diseases. Characteristics of the organ-specific autoimmune diseases. Characteristics of the systemic autoimmune diseases.

13th week:
Lecture: The immune response associated with tissue and organ transplantation. Immunological aspects of Immune reconstitution. Hematopoietic stem-cell transplantation. The immune response to extracellular pathogens.

14th week:
Self Control Test

Requirements

To follow the progress of students one self control test (SCT) will be organised (Week 14). The SCT contains questions about the material of lectures given between week 9-13.
Students who score an average of 51% or above on the SCT will be offered a grade that he/she may accept as a grade for their end-term exam.
Those students who have not qualified for an offered grade must take the end-term exam during the exam period. The end-term exam consists of a written and an oral part.

"A" exam: To qualify for the oral part of an "A" exam, students must score higher than 70% on the written (entry) exam. Students who score less than 70% on the written part will fail (thus, the oral exam will not take place).

"B" exam: "B" exams are identical to "A" exams except when the student failed the oral, but not the written, part of the "A" exam. With a score of higher than 70% on the written part of the "A" exam, the student is exempt from the written exam on the "B" exam.

"C" exam: "C" exams are oral exams only, without a written entry test.
Those students who would like to improve the grade of a successful ("A" or "B" exam) or do not accept the offered grade, are also exempted from the entry test.
The list of exam topics is available on the departmental website (www.immunology.unideb.hu).
Lecture materials and other information concerning education can be found on our website at www.immunology.unideb.hu by clicking the link "For Students".

Department of Medical Chemistry

Subject: **ENZYMOLOGY**
Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **15**
Practical: **60**

3rd week:
Lecture: 1. Enzymes, as biological catalysts. Michaelis-Menten kinetics. 2. Inhibition of enzyme activity. Competitive, noncompetitive, uncompetitive, and mixed types of inhibitors. 3. Methods for the determination of enzyme activity. Environmental factors, stability and interfering substances affecting the enzyme assays.4. Enzyme regulation. Allosteric and covalent controls of enzyme activity. The kinetics of allosteric enzymes.5. Supramolecular enzyme organization. Multienzyme complexes and conjugates. Protein complexes, and compartmentalization.

4th week:
Lecture: Enzymes of lipid and hydrogen peroxide degradation.
Practical: Assay of enzymes of lipid and hydrogen peroxide degradation.

5th week:
Lecture: Transaminases.
Practical: Investigation of transaminases.

6th week:
Lecture: Proteases.
Practical: Assay of proteases.

7th week:
Lecture: Transglutaminases.
Practical: Investigation of transglutaminases.

8th week:
Lecture: β-galactosidase.
Practical: Kinetics of β-galactosidase.
10th week:
Lecture: Mitochondrial metabolism
Practical: Analysis of mitocondrial metabolism

11th week:
Lecture: Glycogen phosphorylase
Practical: Kinetics of glycogen phosphorylase

12th week:
Lecture: Phosphorylase kinase
Practical: Assay of phosphorylase kinase

Requirements

Elective course recommended for the students of the genomics and biochemistry module. Limit of the participants: max. 10 students/semester. Exam: ESE (written test including theoretical and practical questions). The successful completion of the practical classes is a pre-requirement. The exam cannot be started in the absence of the signatures of all practical instructors at the back page.

Subject: **POST-TRANSLATIONAL MODIFICATION OF PROTEINS**
Year, Semester: 2nd year/2nd semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction to posttranslational modifications.

2nd week:
Lecture: Protein phosphorylation: mechanism of phosphorylation. Serine/threonine specific protein kinases.

3rd week:
Lecture: Dephosphorylation of proteins by protein phosphatases: serine//threonine protein phosphatases.

4th week:
Lecture: Protein phosphorylation on tyrosine side-chains: tyrosine kinases and phosphatases.

5th week:
Lecture: Proteolysis: types and catalytic mechanisms of proteolytic enzymes.

6th week:
Lecture: Role of proteinases in the regulation of cellular functions.

7th week:
Lecture: Ubiquitination of proteins.

8th week:
Lecture: Modifications of cysteine side chains in proteins

9th week:
Lecture: Lipid modifications of proteins. Protein hydroxylation.

10th week:
Lecture: Glycosylation of proteins.

11th week:
Lecture: Modification of proteins by methylation and acetylation.

12th week:
Lecture: Protein mono-ADP-ribosylation.

13th week:
Lecture: Poly-ADP-ribosylation of proteins.

14th week:
Lecture: Protein carboxylation and amidation. Transglutaminases.

15th week:
Lecture: Review of posttranslational modifications.

Requirements

The aim of this course is to provide students with specific professional knowledge and understanding the aspects of postsynthetic protein modifications. The program consists of lectures. Attendance at the lectures is highly recommended. The End of Semester Examination is a written test containing two questions. The questions include the topics of all of the lectures. The knowledge of both questions at least at the basic level is required for the passing grade.
Subject: **SIGNALLING PATHWAYS IN THE CELLS**

Year, Semester: 2nd year/1st semester
Number of teaching hours:
Lecture: **30**

1st week:
Lecture: Introduction.

2nd week:
Lecture: Overview of cell signalling mechanisms.

3rd week:
Lecture: Cell signalling pathways.

4th week:
Lecture: Ion channels.

5th week:
Lecture: Sensors and effectors of signalling.

6th week:
Lecture: Spatial and temporal aspects of signalling.

7th week:
Lecture: Signalling in the students' own research projects: choosing topics for students' presentations.

8th week:
Lecture: Off mechanisms.

9th week:
Lecture: Cellular processes.

10th week:
Lecture: Development.

11th week:
Lecture: Cell cycle and proliferation.

12th week:
Lecture: Neuronal signalling.

13th week:
Lecture: Cell stress, inflammatory responses and cell death.

14th week:
Lecture: Signalling defects and diseases.

15th week:
Lecture: Students' presentations.

Requirements

The program consists of lectures. Attendance of the lectures is required and recorded. Evaluation of the student's performance at the end of semester examination includes the quality of student's presentation and the score of a written examination in which questions cover all topics. Improvement of the examination mark is possible by oral examination.

CHAPTER 12
TITLES OF THESES

Institute of Food Science, Quality Assurance and Microbiology

1. Title: Phylogenetic correlation between special sequences for studying fungi
2. Title: Population genetic studies of plant pathogenic fungi
Tutor: Erzsébet Karaffa Ph.D.

Department of Anatomy, Histology and Embryology

1. Title: Expression of extracellular matrix molecules in the olfactory system of the rat
2. Title: The role of the extracellular matrix in the regeneration of the nervous system.
Tutor: Klára Matesz M.D., Ph.D., D.Sc.

3. Title: Possible applications of morphofunctional matrices for classification of neurons (computer modelling)
Tutor: Ervin Wolf M.Sc., Ph.D.

4. Title: Investigation of contour integration processing in the primary visual cortex using voltage sensitive dye imaging
5. Title: Three-dimensional reconstruction of thalamocortical axons in the primary somatosensory cortex of rats
Tutor: Zoltán Kisvárday M.Sc., Ph.D., D.Sc.

6. Title: Investigation of signalling mechanisms that regulate cartilage development and maturation
Tutor: Róza Zákány M.D., Ph.D.

7. Title: Interrogation of spinal dorsal horn circuits with electrophysiological and optogenetic tools
8. Title: Light- and electron microscopy level analysis of the axons and axon collaterals of spinal lamina I projection neurons
9. Title: Local synaptic connections of projection neurons in spinal lamina I
10. Title: Morphometric analysis of excitatory and inhibitory interneurons in the spinal dorsal horn
Tutor: Péter Szücs M.D., Ph.D.

11. Title: Extracellular matrix in the developing brainstem
Tutor: Ildikó Wéber M.Sc., Ph.D.

12. Title: Extracellular matrix molecules in the motor nuclei of the eye in the mouse
13. Title: Regeneration of the optic nerve in the frog
14. Title: Regeneration of the vestibular system in the rat
Tutor: Botond Gaál M.Sc., Ph.D.

15. Title: Investigation of neuronal network development in the spinal cord
Tutor: Zoltán Mészár M.Sc., Ph.D.

16. Title: The role of the molecular clock in healthy and osteoarthritic chondrocytes
Tutor: Csaba Matta M.Sc., Ph.D.

17. Title: Role of PACAP signalling in cartilage differentiation and regeneration
Tutor: Tamás Juhász M.Sc., Ph.D.

18. Title: Distribution of the extracellular matrix in the red nucleus and pararubral area
Tutor: Éva Rácz M.Sc., Ph.D.

19. Title: The endocannabinoid-mediated modulation of spinal nociception
20. Title: The role of astrocytes in spinal pain processing
Tutor: Zoltán Hegyi M.Sc., Ph.D.

21. Title: Quantitative morphological studies of primary afferent-motoneuron connections in the frog's brainstem
Tutor: András Birinyi M.Sc., Ph.D.

22. Title: Role of pro-inflammatory cytokines in neuron-glia interaction during inflammatory pain states
Tutor: Krisztina Holló M.Sc., Ph.D.

23. Title: Mapping of synapses on dendrites of GABAergic neuron subtypes in the cerebral cortex
Tutor: Petra Talapka Ph.D.

Department of Biochemistry and Molecular Biology

1. Title: Involvement of phagocytosis of apoptotic cells in the muscle regeneration following injury
2. Title: Involvement of the impaired clearance of apoptotic cells in the control of insulin sensitivity
3. Title: Molecular mechanisms participating int he engulfment of apoptotic cells
4. Title: Signaling pathways mediating the effect of adenosine in the macrophage chemotaxis
Tutor: Zsuzsa Szondy M.D., Ph.D., D.Sc.

5. Title: The role of retroviral proteases in the retroviral life cycle.
Tutor: József Tőzsér M.Sc., Ph.D., D.Sc.

6. Title: The role of tissue transglutaminase in rolling and adhesion of neutrophil granulocytes
Tutor: Zoltán Balajthy M.Sc., Ph.D.

7. Title: Saliva biomarkers of oral cancer.
Tutor: Beáta Scholtz M.Sc., Ph.D.

8. Title: Production of dendritic cells and macrophages from embryonic stem cells.
9. Title: Transcriptional reprogramming of murine embryonic stem cell progenitors.
Tutor: István Szatmári M.Sc., Ph.D.

10. Title: Effects of various coeliac autoantibodies on transglutaminase 2 activities and interactome.
11. Title: Modification of the enzymatic activity of transglutaminase 2 by site-directed mutagenesis. Therapeutic utilization of modified transglutaminase 2.
12. Title: Studying structure and function relationship of transglutaminases and its application in translational medicine
Tutor: Róbert Király M.Sc., Ph.D.

13. Title: Quantitative proteomic analysis of the tear proteins of diabetic patients.
Tutor: Éva Csősz M.Sc., Ph.D.

14. Title: Evaluation of the browning potential and inducibility from human fat tissue biopsies
Tutor: Mária Szatmári-Tóth M.Sc., Ph.D.

15. Title: Identification of regulatory SNPs in promoter regions of different species by bioinformatic analyses.
Tutor: Endre Barta M.Sc., Ph.D.

16. Title: The role of aim2 protein and native immune response in inhibiting cell proliferation
Tutor: Máté Demény M.D., Ph.D.

17. Title: Alterations in structural properties of the transcription machinery in relation to disease development
18. Title: Drug discovery for protein interactions
19. Title: Functional aggregation in innate immunity
20. Title: Molecular factors in cell differentiation
21. Title: New comparative methods of protein evolution and sequence analysis
22. Title: Regulation of protein half-life via protein interactions
23. Title: Studying the re-programming mechanisms of viral proteins.
24. Title: The role of signaling pathway perturbations in cancer development
Tutor: Mónika Fuxreiter M.Sc., Ph.D., D.Sc.

25. Title: Characterization of adipocytes with thermogenic potential
26. Title: In vitro study about the effect of environmental conditions (e.g.: temperature, oxygen availability) on the differentiation potential and beigeing process of primary adipocytes

27. Title: Investigation of the beigeing plasticity of adipocytes, identification of key extrinsic and intrinsic factors
Tutor: Beáta Bartáné Tóth M.Sc., Ph.D.

28. Title: Investigation of novel molecular elements of the browning machinery in different human adipose tissues
29. Title: Investigation of the biological significance of "batokine" secretion in human cell models
Tutor: Endre Károly Kristóf M.D.

30. Title: Characterization of genetic risk factors of chronic pancreatitis
Tutor: András Szabó M.Sc., Ph.D.

Department of Biophysics and Cell Biology

1. Title: Investigation of cell surface distribution of erbB-2 oncoprotein in breast tumor cell lines.
2. Title: Role of tumor stem cells in trastazumab resistant breast tumors
Tutor: János Szöllősi M.Sc., Ph.D., D.Sc., M.H.A.Sc.

3. Title: Studying the inactivation of voltage gated potassium ion channels in heterologous expression systems.
Tutor: György Panyi M.D., Ph.D., D.Sc.

4. Title: Epigenetic regulation of nucleosome-DNA cohesion
5. Title: Interactions between ABC transporters and their membrane environment
Tutor: Gábor Szabó M.D., Ph.D., D.Sc.

6. Title: Mathematical analysis and computer modelling of the topology of cell surface proteins.
7. Title: Role of MHC in the organization of cell surface proteins
Tutor: László Mátyus M.D., Ph.D., D.Sc.

8. Title: Examination of the channel function properties of the P170 multidrug pump by patch-clamp.
Tutor: Zoltán Krasznai M.Sc., Ph.D.

9. Title: Cytometry of cytotoxic lymphocytes
10. Title: Physiological roles of the multidrug resistance transporter P-glycoprotein.
Tutor: Zsolt Bacsó M.D., Ph.D.

11. Title: Elucidation of the catalytic mechanism of ABC transporters
Tutor: Katalin Goda M.Sc., Ph.D.

12. Title: 3-dimensional reconstruction of chromosome conformations based on whole-genome contact probability data
13. Title: Histone point mutations affecting epigenetic modifications: impact on chromosome architecture
Tutor: Lóránt Székvölgyi M.Sc., Ph.D.

14. Title: Biophysical analysis and functional significance of cell surface protein patterns in T cell-mediated immune responses
Tutor: Andrea Dóczy-Bodnár M.Sc., Ph.D.

15. Title: Studying nuclear receptor function by modern microsocpy techniques
Tutor: György Vámosi M.Sc., Ph.D.

16. Title: Quantitative investigation of the associations of ErbB proteins using biophysical and molecular biological methods
17. Title: The correlation between the metastatic potential and chemoresistance of breast tumors with the expression level and association state of ErbB proteins
Tutor: Péter Nagy M.D., Ph.D.

18. Title: Molecular mechanisms of anticancer immune therapy.
19. Title: Role of molecular interactions between receptor tyrosine kinases and integrins in the therapy resistance of tumors.
Tutor: György Vereb M.D., Ph.D., D.Sc.

20. Title: Comparative study on Kv1.3 channels conjugated with fluorescent proteins
Tutor: Péter Hajdu M.Sc., Ph.D.

Department of Botany

1. Title: Stress tolerance and resistance mechanisms of higher plants
Tutor: Ilona Mészáros M.Sc., Ph.D., C.Sc.

2. Title: The study of chromatin and microtubule organization in cells of higher plants
Tutor: Csaba Máthé M.Sc., Ph.D.

3. Title: Plant bioactive compounds
Tutor: Gábor Vasas M.Sc., Ph.D.

4. Title: Role of glycoproteins in infection and immunology (bibliographic)
Tutor: János Kerékgyártó M.Sc., Ph.D., C.Sc.

Division of Nuclear Medicine and Translational Imaging

1. Title: Development of E-learning material for nuclear medicine
Tutor: József Varga M.Sc., Ph.D.

2. Title: Assessment of Diabetic Foot with Different Nuclear Medicine procedures
Tutor: Ildikó Garai M.D., Ph.D.

Department of Medical Imaging

1. Title: Posttherapeutic I-131 whole body SPECT/CT in patients with thyroid cancer
2. Title: The role of Tc99m-Tektrotyd SPECT/CT to evaluate metastatic neuroendocrine tumors
Tutor: Ildikó Garai M.D., Ph.D.

3. Title: Localisation of anatomical regions of CT scans with machine learning methods
Tutor: Zoltán Barta M.D.

Department of Human Genetics

1. Title: Characterization of factor-C protein family using sequence databases.
2. Title: Expression of WT1 and its splice variants in different diseases studied by real time PCR.
3. Title: Study of a gene regulating differentiation in bacteria.
4. Title: Study of the WT1 gene in urogenital malformations.
Tutor: Sándor Biró M.Sc., Ph.D., D.Sc.

5. Title: Human disease models in animals and lower eukaryotes (review).
Tutor: Zsigmond Fehér M.D., Ph.D.

6. Title: Ca++-binding proteins in Streptomyces
7. Title: Isolation of mono-ADP-ribosylated proteins from pro- and eukaryotic cells.
Tutor: András Penyige M.Sc., Ph.D.

8. Title: Analysis of an A factor non-producer bald mutant Streptomyces griseus strain with respect of antibiotic production and cell differentiation.
Tutor: Zsuzsanna Birkó M.Sc., Ph.D.

9. Title: Chromosome-tracking studies in complex diseases.
Tutor: György Vargha M.D., Ph.D.

10. Title: Factor-C: a protein regulating differentiation in Streptomycetes.
Tutor: Judit Keserű M.Sc., Ph.D.

11. Title: Copy number variation of WT-1 gene in hematological conditions
Tutor: Gergely Buglyó M.D., Ph.D.

12. Title: Functional analysis of the Streptomyces facC gene in Aspergillus
Tutor: Melinda Paholcsek M.Sc., Ph.D.

13. Title: Global analysis of the human blood plasma epitome and interactome in health and disease.
14. Title: Use of comparative monoclonal antibody proteomics to detect three dimensional conservation relevant to protein function.
Tutor: László Takács M.D., Ph.D., D.Sc., M.H.A.Sc.

15. Title: Study of antibiotic production and differentiation in Streptomyces bacteria.
16. Title: Study the role of miRNAs in oncogenic disorders.
Tutor: Melinda Szilágyi-Bónizs M.Sc., Ph.D.

Department of Immunology

1. Title: Phenotypic and functional properties of dendritic cells
Tutor: Éva Rajnavölgyi M.Sc., Ph.D., D.Sc.

2. Title: Functional properties of SLAM receptor family proteins in dendritic cells
3. Title: The role of the HOFI/SH3PXD2B adaptor protein in the regulation of the tumor microenvironment
Tutor: Árpád Lányi M.Sc., Ph.D.

4. Title: The role of innate immune cells in the development of allergic responses
5. Title: The role of innate lympoid cells (ILC) in human diseases
Tutor: Attila Bácsi M.Sc., Ph.D.

6. Title: Altered differentiation of monocyte derived dendritic cells and their functional differences
Tutor: Péter Gogolák M.Sc., Ph.D.

7. Title: Identification of new viral senzors and new regulatory mechanisms in the antiviral responses of human dendritic cells.
Tutor: Kitti Pázmándi M.Sc., Ph.D.

8. Title: Study of non-apoptotic cytotoxic processes during immune response, new way of killing apoptosis resistant tumor cells
Tutor: Gábor Koncz M.Sc., Ph.D.

Department of Medical Chemistry

1. Title: Investigation of Ser/Thr protein phosphatase in pathogenic fungi
Tutor: Viktor Dombrádi M.Sc., Ph.D., D.Sc.

2. Title: Interaction of protein phosphatase 1 catalytic subunit with regulatory proteins
Tutor: Ferenc Erdődi M.Sc., Ph.D., D.Sc.

3. Title: Regulation of macrophage activation
Tutor: László Virág M.D., Ph.D., D.Sc.

4. Title: Scaffolding proteins in the endothelium
Tutor: Csilla Csortos M.Sc., Ph.D., D.Sc.

5. Title: Structural and functional investigation of a fungus specific protein phosphatase
Tutor: Ilona Farkas M.Sc., Ph.D.

6. Title: Study of metabolic processes with special regard to the involvement of mitochondrial activity.
Tutor: Péter Bay M.Sc., Ph.D.

7. Title: Development of High-Content Screening Applications
Tutor: Endre Kókai M.Sc., Ph.D.

8. Title: Signalling pathways in endome
9. Title: Study of the role of protein phosphatase in wound healing
Tutor: Beáta Lontay M.Sc., Ph.D.

10. Title: Inhibition of sodium-glucose cotransporter of kidney by glucose-based compounds also interfering with glycogenolysis
Tutor: Tibor Docsa M.Sc., Ph.D.

11. Title: Regulation of protein phosphatase-1 by inhibitory proteins and the translocation of the targing subunit
Tutor: Andrea Kiss M.Sc., Ph.D.

12. Title: High-Throughput Screening
Tutor: Csaba Hegedűs M.D., L.D.S., Ph.D.

13. Title: Study of protein-protein interaction in the neurodegenerative Huntington's disease.
Tutor: Krisztina Tar M.Sc., Ph.D.

Department of Medical Microbiology

1. Title: Antimicrobial cell-mediated immunity measured by mRNA tests
Tutor: József Kónya M.D., Ph.D., D.Sc.

2. Title: Evaluation of in vitro efficacy of different new antibiotics against multiresistant bacteria
Tutor: Judit Szabó M.D., Ph.D.

3. Title: Role of HPV in head and neck cancers
Tutor: Krisztina Szarka M.Sc., Ph.D.

4. Title: Evaluation of fungicidal effect of

antifungal agents using time-kill curves
5. Title: New and older agents in antifungal chemotherapy
Tutor: László Majoros M.D., Ph.D.

6. Title: Prevalance of human polyomaviruses
Tutor: Eszter Csoma M.Sc., Ph.D.

7. Title: Effects of human papillomavirus oncoproteins on cellular signaling pathways in keratinocytes
Tutor: Anita Szalmás M.Sc., Ph.D.

8. Title: Molecular epidemiology of aminoglycoside resistance in nosocomial Gram negative bacteria
Tutor: Gábor Kardos M.D., Ph.D.

9. Title: Intratypical variation of human papillomaviruses
Tutor: György Veress M.Sc., Ph.D.

10. Title: The importance of fungal quorum-sensing in antifungal therapy against Candida biofilms.
Tutor: Renátó Kovács M.Sc., Ph.D.

Department of Internal Medicine

1. Title: Immunotherapy of B cell lymphomas.
2. Title: Safety profile of prolonged rituximab therapy in lymphomas.
3. Title: Targeted therapy in non-Hodgkin's lymphomas
Tutor: Lajos Gergely M.D., Ph.D. habil.

4. Title: Clinical testing of sinus node function.
Tutor: Péter Kovács M.D., DLA, Ph.D., D.Sc.

5. Title: Lipid abnormalities in hypothyreoidism.
6. Title: The function of LDL in lipid metabolism
Tutor: György Paragh M.D., Ph.D., D.Sc.

7. Title: Diagnostic tests and imaging techniques in endocrinology.
Tutor: Endre Nagy M.D., Ph.D., D.Sc.

8. Title: Antiarrhythmic drug treatment.
9. Title: Cardiac arrhythmias in patients end-stage renal failure.
10. Title: Pacemaker treatment and myocardial infarction.
11. Title: Pathophysiology of neurocardiogenic syncope.
12. Title: Rhythm disturbances and the autonomic system of the heart.
13. Title: Ventricular repolarization and drugs.
Tutor: István Lőrincz M.D., Ph.D.

14. Title: Investigations of lipoproteins in normo- and hypercholesterinemic patients.
Tutor: Judit Boda M.D.

15. Title: Adipokines and Insulin Resistance
16. Title: Obesity: Diagnosis and Treatment
17. Title: Obesity: Etiology and Co-morbidities
Tutor: Péter Fülöp M.D., Ph.D.

18. Title: Characteristics of rare systemic vasculitides
19. Title: Sjögren's syndrome associated with other autoimmune disease
Tutor: Margit Zeher M.D., Ph.D., D.Sc.

20. Title: Immunoregulatory abnormality in undifferentiated connective tissue disease
21. Title: Interstitial lung diseases in MCTD.
22. Title: The presence of antiphospholipide antibodies in the disease course of the MCTD
23. Title: Vascular involvement in mixed connective tissue disease.
24. Title: Vascular risk factors in undifferentiated connective tissue disease
Tutor: Edit Bodolay M.D., Ph.D., D.Sc.

25. Title: Dermato/polymyositis overlap with antiphospolipide syndrome.
26. Title: Genetical study in myositis
27. Title: Improvement of quality of life in polymyositis and dermatomyositis patients by physiotherapy
Tutor: Katalin Dankó M.D., Ph.D., D.Sc.

28. Title: Plasmapheresis treatment in intensive therapy
Tutor: Pál Soltész M.D., Ph.D., D.Sc.

29. Title: Autoimmune disorders and GI tract
Tutor: Zsolt Barta M.D., Ph.D.

30. Title: Ischemic colitis.
31. Title: Life quality of Raynaud syndrome
Tutor: Zoltán Csiki M.D., Ph.D.

32. Title: The disease course after stent inplantation in peripheral arterial disease
Tutor: György Kerekes M.D., Ph.D.

33. Title: Novel therapeutical approaches in multiple myeloma
34. Title: The impact of multi-drug resistance genes in the prognosis of lymphoproliferative disorders
Tutor: László Váróczy M.D., Ph.D. habil.

35. Title: Inherited and acquired thrombophilia
36. Title: New direct oral anticoagulants
37. Title: Stem cell therapy in peripheral arterial disorders
Tutor: Zoltán Boda M.D., Ph.D., D.Sc.

38. Title: Gastric cancer: clinics and treatment
39. Title: Gastrointestinal bleeding
40. Title: Gluten sensitive enteropathy
41. Title: Inflammatory bowel diseases.
42. Title: Lymphomas in the gastrointestinal tract.
Tutor: István Altorjay M.D., Ph.D., D.Sc.

43. Title: Langerhans histiocytosis
44. Title: Osteosclerotic myeloma
45. Title: Therapeutic challenges in rare haemostatic disorders
Tutor: György Pfliegler M.D., Ph.D.

46. Title: Epidemiology, diagnostics and therapy of chronic hepatitis C
47. Title: Pathomechanism of alcoholic hepatitis
48. Title: Signs, diagnostics and treatment of portal hypertension.
49. Title: Therapeutic options in primary sclerotizing cholangitis
50. Title: Treatment of autoimmune hepatitis
Tutor: István Tornai M.D., Ph.D. habil.

51. Title: A case history of an interesting acute myeloid leukaemia patient in the 2nd Department of Medicine (connection with the literature data)
Tutor: Attila Kiss M.Sc., Ph.D.

52. Title: Chronic neutrophilic leukaemia
Tutor: Béla Telek M.D., Ph.D.

53. Title: Biological treatment of ulcerative colitis
54. Title: Extraintestinal association in IBD
Tutor: Károly Palatka M.D., Ph.D. habil.

55. Title: The role of Willebrand factor in various internal diseases.
Tutor: Ágota Schlammadinger M.D., Ph.D.

56. Title: Bacterial infection in liver cirrhosis
57. Title: Clinical significance of chronic pancreatitis
58. Title: Current therapeutic options of acute pancreatitis
Tutor: Zsuzsa Vitális M.D., Ph.D.

59. Title: Diagnosis and treatment of chronic lymphocytic leukemia
60. Title: Novel therapeutic approches in the treatment of multiple myeloma
61. Title: Philadelphia negative chronic myeloproliferative neoplasms - novel genetic and therapeutic improvements
62. Title: Recent advances in the management of chronic ITP
Tutor: Péter Batár M.D., Ph.D.

63. Title: Are the bacterial infections predictable in liver cirrhosis?
64. Title: Role of serological markers in prediction of disease course and response to therapy in inflammatory bowel diseases.
Tutor: Mária Papp M.D., M.Sc., Ph.D. habil.

65. Title: Gastoesophageal reflux disease
Tutor: László Dávida M.D.

Department of Pharmacology and Pharmacotherapy

1. Title: Cardiovascular risk factors

2. Title: Metabolic link between obesity and insulin resistance
Tutor: Zoltán Szilvássy M.D., Ph.D., D.Sc.

3. Title: Arrhythmic patient in dentistry
4. Title: Optional title in pharmacology
5. Title: Pharmacological and clinical significance of adenosine receptor antagonists
6. Title: Pharmacological and non-pharmacological treatment of endothelial dysfunction
7. Title: Pharmacology of antidepressive drugs: dental implications
Tutor: József Szentmiklósi M.D., Ph.D.

8. Title: Emerging roles of prostaglandin DP1 and DP2 receptors in acute and chronic aspects of allergic diseases
9. Title: Optional title in pharmacology
10. Title: Pharmacological treatment of acute decompensated heart failure (ADHF)
11. Title: Pharmacology of herbal remedies
12. Title: Pharmacology of neurogenic inflammation
13. Title: Pharmacotherapy of Amyotrophic Lateral Sclerosis (ALS)
14. Title: Pharmacotherapy of Duchenne Muscular Dystrophy (DMD)
15. Title: Possible pharmacological exploitations of TRPV1 receptors
16. Title: Use of Histone deacetylase inhibitors (HDI): Novel advances in cancer treatment
Tutor: Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.

17. Title: Effect of colony stimulating factors or other drugs on bone marrow-derived cell lines
18. Title: How insulin resistance influences drug effects
19. Title: Selected topic in field experimental hemato-oncology
Tutor: Ilona Benkő M.D., Ph.D.

20. Title: Optional title on cancer chemotherapy
Tutor: Attila Megyeri M.D., Ph.D.

21. Title: Optional title in pharmacology
Tutor: Ágnes Cseppentő M.D.

22. Title: Optional title on antibacterial chemotherapy
Tutor: Zsuzsanna Gál M.Sc., Ph.D.

23. Title: Optional title in pharmacology
Tutor: Béla Juhász D.Pharm., Dr. habil., Ph.D.

24. Title: Optional title in pharmacology
Tutor: Balázs Varga D.Pharm., Ph.D.

25. Title: Optional title in pharmacology
Tutor: Mariann Bombicz D.Pharm.

26. Title: Optional title in pharmacology
Tutor: Dániel Priksz D.Pharm.

Department of Physiology

1. Title: Expression and significance of the TASK channels in physiological and pathological conditions
Tutor: Péter Szücs M.D., Ph.D.

2. Title: Alterations of intracellular calcium concentration in pathological conditions
Tutor: László Csernoch M.Sc., Ph.D., D.Sc.

3. Title: Regional differences in the electrophysiological properties of cardiomyocytes
Tutor: Péter Nánási M.D., Ph.D., D.Sc.

4. Title: Role of afterdepolarization mechanisms in the arrhythmogenesis
Tutor: Tamás Bányász M.D., Ph.D.

5. Title: Electrophysiological properties of mammalian cardiac tissues
Tutor: János Magyar M.D., Ph.D., D.Sc.

6. Title: Beat-to beat variability of cardiac repolarization
Tutor: Norbert Szentandrássy M.D., Ph.D.

7. Title: Studies on ion channels incorporated into artificial membranes
Tutor: István Jóna M.Sc., Ph.D., D.Sc.

8. Title: Role of late sodium current in the arrhythmogenesis
Tutor: Balázs Horváth M.D., Ph.D.

9. Title: Role of potassium channels in neuron function
Tutor: Balázs Pál M.D., Ph.D.

10. Title: Properties of vanilloid receptors
Tutor: István Balázs Tóth M.Sc., Ph.D.

11. Title: Role of Protein Kinase C isoforms in cell function.
Tutor: Gabriella Czifra M.Sc., Ph.D.

CHAPTER 13
LIST OF TEXTBOOKS

BMC

Introduction to Biophysics I.:

Serway/Vuille: College Physics.
10th edition. Cengage Learning, 2014. ISBN: 978-1285737027.
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University of Debrecen.

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F., Erdődi, Cs., Csortos: Organic Chemistry for Premedical Students.
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Gerő Ildikó-Kovács Judit: Színesen magyarul.
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Sadava, Hillis, Heller, Berenbaum: Life: The Science of Biology.
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Introduction to Medical Chemistry:

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J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual.
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Peter Parham: The Immune System.
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Damjanovich, S., Fidy, J., Szöllősi, J.: Medical Biophysics.
1st edition. Medicina, 2009. ISBN: 978 963 226 249 9.

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Practical Courses in Genetics.
University Medical School of Debrecen, 2002.
Robert L. Nussbaum, Roderick R. McInnes, Huntington F. Willard, Ada Hamosh: Thompson and Thompson Genetics in Medicine.
8th edition. Saunders Elsevier, 2016. ISBN: 978-1-4377-0696-3.
Tom Strachan, Andrew P. Read: Human Molecular Genetics.
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Campbell, A. M., Heyer, L. J.: Discovering genomics, proteomics and bioinformatics.
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Taiz, L., Zeiger, E.: Plant Physiology.
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Notes.

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