

BULLETIN

UNIVERSITY OF DEBRECEN

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MSc in Molecular Biology

FACULTY OF MEDICINE

Coordinating Center for International Education

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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 40 departments; including 22 different clinical departments. 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.

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 27 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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	Péter Török M.D., Ph.D. habil.
	Ms. Orsolya Valkó M.Sc., Ph.D.
Assistant Lecturer	István Gyulai M.Sc.
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	István Fábián M.Sc., Ph.D., D.Sc.
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Professor Emeritus	Ernő Brücher Ph.D., D.Sc., M.Sc.
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	Ms. Ágnes Fejesné Dávid M.Sc., Ph.D.
	Ms. Linda Földi-Bíró M.Sc., Ph.D.
	Norbert Lihi M.Sc., Ph.D.
	Ms. Melinda Pokoraczkiné András M.Sc., Ph.D.
	Ms. Annamária Sebestyén M.Sc., Ph.D.
	Ms. Mária Szabó M.Sc., Ph.D.
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	Tamás Gyöngyösi M.Sc.
	Ms. Petra Herman M.Sc.
	Ms. Ágnes Judit Hőgyéné Grenács M.Sc., Ph.D.
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	Ms. Tóth Marietta Vágvolgyiné M.Sc., Ph.D. habil.
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	Ms. Tóth Éva Juhászné M.Sc., Ph.D.
	Ms. Krisztina Kónya M.Sc., Ph.D.
	Sándor Kun M.Sc., Ph.D.
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CHAPTER 7 UNIVERSITY CALENDAR

UNIVERSITY CALENDAR for MSc in MOLECULAR BIOLOGY PROGRAM 2021/2022 ACADEMIC YEAR

OPENING CEREMONY: September 5, 2021

GRADUATION CEREMONY: June/July 2022;

1st SEMESTER

Year	Course	Examination Period
1 st year M.Sc. in Molecular Biology 2 nd year M.Sc. in Molecular Biology	September 6 – December 10, 2021 (14 weeks)	December 13, 2021 – January 28, 2022 (7 weeks)

2nd SEMESTER

Year	Course	Examination Period
1 st year M.Sc. in Molecular Biology	February 7 – May 13, 2022 (14 weeks)	May 16 – July 1, 2022 (7 weeks)
2 nd year M.Sc. in Molecular Biology (before graduation)	February 7 – April 29, 2022 (12 weeks)	May 2 – June 10, 2022 (6 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	28	14		ESE*	4	None
1	Biophysics	AO_MBE_BIF21	28	9		ESE	3	None
1	Human Physiology I.	AO_MBE_HET01	28			ESE*	3	None
1	Hungarian Language I.	AO_MBE_HUL01			40	AW5	0	None
1	Medical Genome Biology	AO_MBE_MGB01	28		42	ESE*	5	None
1	Methods of Molecular Biology	AO_MBE_MBE01	28			ESE*	3	None
1	Molecular Genetics	AO_MBE_GEN01	28		28	ESE*	4	None
1	Molecular Immunology	AO_MBE_IMM014	28	14		ESE*	3	None
1	Physical Education	SI-003			28	SIGN	0	None
1	Radioisotope Techniques in Biomedicine	AO_MBE_ITE01	28			ESE	3	None
1	Radioisotope Techniques In Biomedicine Practical	AO_MBE_ITG01			14	AW5	1	together with Radioisotope Techniques in Biomedicine

Compulsory courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Bioinformatics	AO_MBE_BIE02	28			ESE	3	None
2	Bioinformatics Practicals	AO_MBE_BIG02			14	AW5	1	together with Bioinformatics
2	Biostatistics	AO_MBE_BST02	14			ESE	1	None
2	Cell and Organ Biochemistry	AO_MBE_CBI02	28	14	14	ESE*	4	Biochemistry of Metabolism
2	Cell Biology	AO_MBE_SBI022	28			ESE*	3	None
2	Human Physiology II.	AO_MBE_HET02	28			ESE*	3	Human Physiology I.
2	Human Physiology Practicals	AO_MBE_HEG02			28	AW5	2	Human Physiology I.; together with Human Physiology II.
2	Hungarian Language II.	AO_MBE_HUL02			40	AW5	0	None
2	Methods in Molecular Biology Practicals	AO_MBE_MBG01			46	AW5	2	Methods of Molecular Biology
2	Physiology of Prokaryotes and Molecular Virology	AO_MBE_PRO02	28		14	ESE	4	None
2	Plant Molecular Biology	AO_MBE_NBI02	28	28		ESE	4	None
2	Problem-solving Exercises in Molecular Biology	AO_MBE_PMF02			45	AW5	2	None
2	Thesis project work I.	AO_MB_DD02			70	AW5	5	None

Compulsory courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Thesis project work II.	AO_MB_DD03			150	AW5	10	Thesis I.

Compulsory courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Thesis project work III.	AO_MB_DD04			210	AW5	15	Thesis II.

Required elective courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Biochemistry Practical I.	AO_MBE_BKG3			42	AW5	2	None

Freely Chosen Courses

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Biochemistry and Molecular Biology	Adipose tissue biology and molecular mechanisms in the pathogenesis of obesity	AOG167906	1	2	20	AW5	None	Endre Károly Kristóf M.D., Ph.D.
Department of Immunology	Impaired Signal Transduction in the Immune System	AO_MBE_I TZ03	2	1	15	ESE	Molecular Immunology	Kitti Pázmándi M.Sc., Ph.D.
Department of Immunology	Immunological Methods in Molecular Biology	AO_MBE_I MM02	3	2	30	ESE	Molecular Immunology	Péter Gogolák M.Sc., Ph.D.
Department of Immunology	New System Biology Paradigms in Immunology	AO_MBE_U PI02	3	2	11	ESE	Molecular Immunology	Kitti Pázmándi M.Sc., Ph.D.
Department of Immunology	Basis of Conventional and Biological Immunotherapies	AO_MBE_H BI03	2	2	30	ESE	Impaired Signal Transduction in the Immune System	Árpád Lányi M.Sc., Ph.D.
Department of Medical Microbiology	Vaccines	AOG4291505	2	1	28	AW5	Physiology of Prokaryotes and Molecular Virology	Krisztina Szarka M.Sc., Ph.D.
Department of Medical Microbiology	One Health: the role of animals and the environment in the evolution and epidemiology of infectious diseases	AOG4291705	1	1	15	AW5	None	Gábor Kardos M.D., Ph.D.
Department of Pharmacology and Pharmacotherapy	Introduction to Ayurveda and Integrative Practice of Clinical Medicine I.	AOG24950	2	1	26	AW5	None	Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.
Department of Pharmacology and Pharmacotherapy	Introduction to Ayurveda and Integrative Practice of Clinical Medicine II.	AOG24951	2	2	26	AW5	Introduction to Ayurveda and Integrative Practice of Clinical Medicine I.	Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.
Division of Clinical Physiology	Basics of Molecular Biology and its application	AOG337801	5	1	60	AW5	None	Attila Tóth M.Sc., Ph.D., D.Sc.
Division of Radiology and Imaging Science	Nobel prize and molecular biology	AO_MBE_N PR03	1	1	14	ESE	None	Teréz Nyesténé Nagy M.D., B.Sc.

**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	Cell Biology Practice	AO_MBE_SBG42			15	AW5	3	together with Cell Biology
2	Proteomics	AO_MBE_PRO04	28		28	ESE	4	None
2	Structure and Function of Macromolecules	AO_MBE_MMS02	14		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	14		28	ESE	3	Medical Genom Biology
1	Genomic Bioinformatics	AO_MBE_BGI02	14		28	ESE	3	Medical Genom Biology
1	Introduction to Molecular Medicine	AO_MBE_IMM03	25			ESE	2	Medical Genome Biology
1	Signalling Pathways in the Cells	AO_MBE_SJF03	28			ESE	3	Cell and Organ Biochemistry

**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
2	Enzymology	AO_MBE_ENZ03	10		42	AW5	4	Biochemistry of Metabolism
2	Post-translational Modification of Proteins	AO_MBE_FPT04	28			ESE	3	Cell and Organ Biochemistry
2	Retroviral Biochemistry	AO_MBE_REB04	22			ESE	3	None
2	Selected Topics in Molecular Cell Biology	AO_MBE_TMC02	30			ESE	3	Methods in Molecular Biology

MSc in Molecular Biology - Specialization Module in Biochemistry-Genomics Freely chosen courses

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Biochemistry and Molecular Biology	Biochemistry of Apoptosis	AO_MBE_A BI03	3	1	28	ESE	Cell and Organ Biochemistry	
Department of Biochemistry and Molecular Biology	Research Techniques in Biochemistry	AO_MBE_MBKTB2	3	2	60	AW5	Biochemistry of Metabolism	József Tózsér M.Sc., Ph.D., D.Sc.
Department of Medical Chemistry	Bioinorganic Chemistry	AO_MBE_B SZ03	3	1	28	ESE	None	Ferenc Erdódi M.Sc., Ph.D., D.Sc.
Division of Cell Biology	Selected Topics in Cell Biology	AO_MB_ST C04	2	2	24	ESE	Cell Biology	György Vereb M.D., Ph.D., D.Sc.

MSc in Molecular Biology - Specialization Module in Immunology, Cell- and Microbiology
Required elective courses for the 1. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Cell Biology Practice	AO_MBE_SBG42			15	AW5	3	together with Cell Biology

MSc in Molecular Biology - Specialization Module in Immunology, Cell- and Microbiology
Required elective courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
1	Human Pathogenic Bacteria	AO_MBE_HBE03	28			ESE	2	Physiology of Prokaryotes and Molecular Virology
1	Human Pathogenic Bacteria Practicals	AO_MBE_HBG03			14	AW5	1	together with Human Pathogenic Bacteria
1	Impaired Signal Transduction in the Immune System	AO_MBE_ITZ03	15			ESE	2	Molecular Immunology
1	Signalling Pathways in the Cells	AO_MBE_SJF03	28			ESE	3	Cell and Organ Biochemistry

MSc in Molecular Biology - Specialization Module in Immunology, Cell- and Microbiology
Required elective courses for the 2. year

Sem	Subjects	Neptun code	L	S	P	Exam	Crd	Prerequisites of taking the subject
2	Basis of Conventional and Biological Immunotherapies	AO_MBE_HBI03	30			ESE	2	Impaired Signal Transduction in the Immune System
2	Cell Analysis	AO_MBE_CAN4			28	AW5	2	Fluorescence experimental methods
2	Human Pathogenic Viruses	AO_MBE_HBE04	28			ESE	2	Physiology of Prokaryotes and Molecular Virology
2	Immunological Methods in Molecular Biology	AO_MBE_IMM02	15		15	ESE	3	Molecular Immunology
2	New System Biology Paradigms in Immunology	AO_MBE_UPI02		11		ESE	3	Molecular Immunology
2	Selected Topics in Cell Biology	AO_MB_STC04	24			ESE	2	Cell Biology
2	Selected Topics in Molecular Cell Biology	AO_MBE_TMC02	30			ESE	3	Methods of Molecular Biology

MSc in Molecular Biology - Specialization Module in Immunology, Cell- and Microbiology
Freely chosen courses

Department	Subject	Neptun code	Crd	Sem	Hours	Exam	Prerequisites of taking the subject	Coordinator
Department of Biochemistry and Molecular Biology	Biochemistry of Apoptosis	AO_MBE_A BI03	3	1	28	ESE	Cell and Organ Biochemistry	
Department of Immunology	Selected topics of Immunology	AOG297206	2	2	20	ESE	Molecular Immunology	Kitti Pázmándi M.Sc., Ph.D.
Department of Immunology	Trends and current developments in vaccination	AOG297406	2	2	28	ESE	Molecular Immunology	Gábor Koncz M.Sc., Ph.D.
Department of Medical Chemistry	Bioinorganic Chemistry	AO_MBE_B SZ03	3	1	28	ESE	None	Ferenc Erdődi M.Sc., Ph.D., D.Sc.
Department of Medical Microbiology	Vaccines	AOG429150 5	2	1	28	AW5	None	Krisztina Szarka M.Sc., Ph.D.
Department of Medical Microbiology	One Health: the role of animals and the environment in the evolution and epidemiology of infectious diseases	AOG429170 5	1	1	15	AW5	None	Gábor Kardos M.D., Ph.D.
Department of Medical Microbiology	Zoonoses	AO_MBE_Z OO04	1	2	14	ESE	Physiology of Prokaryotes and Molecular Virology	

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: **28**

Seminar: **14**

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.

Self Control Test (Topics of weeks 8-14)

Requirements

Course content:

Topics of metabolism presented at the lectures and discussed during the seminars (lecture slides are available at the <https://elearning.med.unideb.hu> web site, login with your university network ID and password). 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. 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 2 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 both tests a total of maximum 100 points can be collected. If the combined score of the tests is above 60% of the total score, grades will be offered based on the 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, or the score of the written examination during the exam period, based on a five-grade scale.

Test grading:

Pass (grade 2): 60-69 points;

Satisfactory (grade 3): 70-79 points;

Good (grade 4): 80-89 points;

Excellent (grade 5): 90-100 points.

The written exams also consist of single-choice and multiple-choice test questions. 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, 1corridor), and on the website.

Course content:

Topics of metabolism presented at the lectures and discussed during the seminars (lecture slides are available at the <https://elearning.med.unideb.hu> website).

End-of-semester exam (ESE): written exam. The written exam consists of test questions, and maximum 100 points can be collected. 60 points (60%) is needed to get a passing grade.

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.

More information about the dates and organization of the written exam will be announced later.

Department of Foreign Languages

Subject: **HUNGARIAN LANGUAGE I.**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Practical: **40**

1st week:

Practical: Greetings, the alphabet, numbers 0-20, colours, everyday expressions, nationalities.

2nd week:

Practical: Languages, numbers 21-29, names of places, the days of the week, numbers 30-100, the time, *hány óra van?*

3rd week:

Practical: Test your knowledge I., adjectives and adverbs, verbs expressing activities.

4th week:

Practical: Times of day, *hány órakor?*, numbers 1000-1000000000, verbs expressing activities 2, everyday expressions, ordinal numbers.

5th week:

Practical: Revision, everyday objects, food and drink, adverbs of frequency.

Self Control Test (Mid-term test)

6th week:

Practical: Food, drinks, fruit, vegetables, the menu, ordering in a restaurant, shopping in the market, the uses of *tessék*, the weather.

7th week:

Practical: The seasons and months, clothes. Test your knowledge 2.

8th week:

Practical: Body parts, adjectives and descriptions, accessories, jobs, places.

9th week:

Practical: Personal details and filling in a form, family relations.

10th week:

Practical: Revision

Self Control Test (Written and oral test)

Requirements

Requirements of the course:

Attendance

Attending language classes is compulsory. If a student is late it is considered as an absence. Students can miss only 10 percent of the classes that is maximum 2 occasions.

The teacher evaluates active participation in each class. Students are not supposed to share coursebooks in the classes therefore if they fail to bring the coursebook to the class for the second time the attendance is refused.

Testing, evaluation

In each Hungarian language course, students must sit for 2 written language tests and an oral exam. A further minimum requirement is the knowledge of 200 words per semester divided into 10 word quizzes. There are five word quizzes before and another five after the midterm test. If a student fails or misses any word quizzes he / she cannot take the written test. A word quiz can be postponed by a week and students can take it only with their own teacher.

The oral exam consists of a role-play from a list of situations covered in the coursebook. If students fail the oral exam, they fail the whole course. The results of the written tests and the oral exam are combined and averaged.

Based on the final score the grades are given as follows.

Final score	Grade
0-59	fail (1)
60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the final score of the written tests is below 60, the student can take a written remedial exam once covering the whole semester's material.

Coursebook:

See the website of the Department of Foreign Languages: ilekt.med.unideb.hu.

Audio files to the course book, oral exam topics and vocabulary minimum lists are also available on the website.

Department of Human Genetics

Subject: **MEDICAL GENOME BIOLOGY**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

Practical: **42**

1st week:

Lecture: Introduction into genomics.

Practical: Introduction.

2nd week:

Lecture: The technology of DNA sequencing, DNA microarrays, RNA-seq.

Practical: Introduction to sequence alignment, BLAST

3rd week:

Lecture: Variability of the human genome. New generation sequencing, HAPMAP and 1000

genome Projects.

Practical: Databases

4th week:

Lecture: Cell-free nucleic acids: characteristics and applications.

Practical: Analysis of gene expression data with the GEO database.

5th week:

Lecture: The genetics of cancer.

Practical: Genetics polymorphisms - disease association, using dbSNP, complex diseases.

6th week:

Lecture: Biostatistics and bioinformatics in global genome and transcriptome analysis.

Practical: Introduction to network analysis, PPI networks, using the STRING tool.

7th week:

Lecture: GWAS analysis, personalized Medicine.

Practical: Complex genetic analysis through an example: kRAS.

8th week:

Lecture: Global analysis of gene expression.

Practical: Epigenetics - use of RNAseq data, DNA methylation.

9th week:

Lecture: Epigenomics and Functional genomic.

Practical: RNA sequencing.

10th week:

Lecture: System biology.

Practical: Exon seq, WHGS, GWAS analysis,

database, sequence variant analysis.

11th week:

Lecture: Biomarkers in diagnostics.

Practical: Expression analysis in diseases, biological experiments.

12th week:

Lecture: Applied genome analysis in drug research.

Practical: Phenotypes with complex genetics, disease analysis based on interactive GWAS database analysis.

13th week:

Lecture: Gene maps and polygenic diseases. Genomics of complex diseases.

Practical: Consultation.

14th week:

Lecture: Minisymposium.

Practical: Short presentations.

Integrative biology, genome-scale information.

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 30% of the lectures is compulsory. If the number of absences exceeds 30% of the lectures the signature will be refused.

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 refused 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).

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: **28**

Practical: **28**

1st week:

Lecture: 1. Introduction into molecular genetics. Organization of genetic material in pro- and eukaryotic cells. 2. Cytogenetics I. Karyogram, ideogram, banding techniques. Human autosomal trisomies.

Practical: Methods of study, required and advised readings. Laboratory safety in the laboratory. Nucleus and chromatin. Cell division.

2nd week:

Lecture: 3. Cytogenetics II. Abnormalities of the X and Y chromosomes. Structural aberrations of human chromosomes. 4. Cytogenetics III. Sex determination in humans. Molecular cytogenetics.

Practical: Cytogenetics. Evaluation of karyograms

3rd week:

Lecture: 5. The function of genes. Gene expression. 6. Genetic code. Translation.

Practical: Gene structure, function (gene, DNS replication, transcription, translation).

4th week:

Lecture: 7. Bacterial genetics. 8. Gene regulation in prokaryotes.

Practical: Gene regulation in prokaryotes. Bacterial genetics.

5th week:

Lecture: 9. The structure of the genes and gene regulation in eukaryotes. The genes of immunoglobulines. 10. Epigenetics. Imprinting. Uniparental disomy.

Practical: Gene regulation in eukaryotes.

Self Control Test (1st self-control test in extra time.)

6th week:

Lecture: 11. Repair of the DNA. Mutagenic agents. Ames test. Dinamic mutations. 12.

Molecular genetics of the cell cycle.

Practical: Mutation, repair, Ames-test.

7th week:

Lecture: 13. Oncogenetics. 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. Genetic polimorhism I. Allelic polymorhism. X-linked genes. 16. Dihybrid cross. Mendel's 2nd law and meiosis. Linked and not-linked genes. Recombination of non-allelic genes. Genetic mapping.

Practical: Problem solving and seminar on mendelian genetics.

9th week:

Lecture: 17. Gene interactions, epistasis, lethal genes. Variations of the gene expression. LOD score. 18. Extranuclear inheritance. Mutations in mitochondrial genes.

Practical: Pedigree analysis. Basic of the human genetics. Seminar on molecular genetics of inherited human diseases.

10th week:

Lecture: 19. Genetic polymorphisms II. Human genetic diversity. Genetics of blood types. 20. Genetic polymorphisms III. Genetics of MHC. DNS-polymorphisms as alleles: RFLP, SNP, micro-, minisatellites. Copy number variations.

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. The genetic basis of complex

inheritance. 22. Genetic polymorphisms IV. Pharmacogenetics, pharmacogenomics. Ecogenetics and ecogenomics.
Practical: Transformation of *Escherichia coli*. Complementation test. The gene concept.

12th week:

Lecture: 23. Population genetics. Hardy-Weinberg equilibrium. Inbreeding. Genetical basis of evolution. 24. Transposable elements.
Practical: Detection of human DNA polymorphism by polymerase chain reaction.

13th week:

Lecture: 25. The genetic role of RNA. 26.

Developmental genetics.

Practical: PCR evaluation of the human polymorphism experiment. Induction of beta-galactosidase in *E. coli* cells.

14th week:

Lecture: 27. Clinical applications of new biotechnology techniques. 28. Results of Human Genom Project.

Practical: Seminar on population genetics.

Self Control Test (3rd self-control test in extra time.)

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 30% 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

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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 homework 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 (%)
40.00 - 44.99	1
44.50 - 48.99	2
49.00 - 53.49	3
53.50 - 57.99	4
58.00 - 61.49	5
62.50 - 66.99	6
67.00 - 71.49	7
71.50 - 75.99	8
76.00 - 80.49	9
80.50 - 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: **28**

Seminar: **14**

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

Seminar: 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.

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.

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

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. The role of innate lymphoid cells in immunresponse.

Seminar: B- lymphocytes. An introduction to antibody structure and function. Inflammation and the acute phase response.

5th week:

Lecture: Generation of B-cell receptor diversity. Antigen-independent differentiation of B-lymphocytes. Antigen-dependent differentiation of B-lymphocytes. B-cell activation. Production of various antibody isotypes and their functions.

Seminar: The innate arm of the immune system.
Self Control Test

6th week:

Lecture: Effector functions of helper T-cells. Activation and functions of cytotoxic T-lymphocytes. T-cell development. Central tolerance. Mechanisms of peripheral tolerance.

Seminar: Generation of B-cell receptor diversity. Antigen-independent differentiation of B-lymphocytes. B-cell development.

7th week:

Lecture: The functions of regulatory T-cells. The development of immunological memory. Monoclonal antibodies. Vaccination.

Seminar: Effector functions of helper T-cells. Activation and functions of cytotoxic T-lymphocytes. T-cell development. Central tolerance. Mechanisms of peripheral tolerance.

8th week:

Seminar: The functions of regulatory T-cells. The development of immunological memory. Monoclonal antibodies. Vaccination.

9th week:

Self Control Test

Requirements

Signing of the Lecture Book:

Participation in the Seminars is compulsory, 1 absence is allowed. If there are more 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 tests (SCT) will be organised (weeks 5 and 9).

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 4-7, respectively including the materials the material

of seminars 5-8.

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.elearning.med.unideb.hu).

Lecture materials and other information concerning education can be found on our website at www.elearning.med.unideb.hu.

Department of Medical Chemistry

Subject: **METHODS OF MOLECULAR BIOLOGY**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture: 1. Isolation of nucleic acids
2. Enzymes of nucleic acid manipulation

2nd week:

Lecture: 3. Cloning of DNA
4. DNA libraries

3rd week:

Lecture: 5. Nucleic acid hybridization
6. DNA chips

4th week:

Lecture: 7. Fluorescence *in situ* hybridization (FISH)

8. Comparative genomic hybridization (CGH)

5th week:

Lecture: 9. PCR and LCR
10. PCR applications
1st control test

6th week:

Lecture: 11. *In vitro* mutagenesis
12. Genome editing

7th week:

Lecture: 13. Genome projects
14. New generation DNA sequencing

8th week:

Lecture: 15. Protein purification
16. Protein analysis
2nd control test

9th week:

Lecture: 17. Preparation of antibodies
18. Immunological methods in molecular biology

10th week:

Lecture: 19. Detection of protein-protein interactions
20. Quantitative analysis of protein interactions

11th week:

Lecture: 21. Proteomics

22. Mass spectroscopy for protein analysis
3rd control test

12th week:

Lecture: 23. Expression of recombinant proteins
24. Biotechnology

13th week:

Lecture: 25. Gene silencing and KO animals
26. Gene therapy

14th week:

Lecture: Discussion
4th control test

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. The course is divided into four teaching blocks. At the end of each block a written self-control test will be held to evaluate the midterm progress of the students. The self-control tests will be evaluated according to the following table:

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

The average result of these tests will be used as an offered mark at the end of the semester, provided all of the tests were successfully completed at least with a passing grade. The students are expected to accept these offered grades in the Neptun system before the start of the examination period. In the absence of an accepted offered grade the students have to sit for an ESE during the exam period in accord with the rules and regulations of the Faculty of Medicine, University of Debrecen.

ESE is a written test composed of four assay questions, each covering a lecture of the given teaching block as described below:

1st block: Lectures 1-8

2nd block: Lectures 9-14

3rd block: Lectures 15-20

4th block: Lectures 21-26

The knowledge of each block at least at the basic level is required for the passing grade.

Textbook:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual, 3rd edition, Cold

Spring Harbor Laboratory Press, 2001

Materials published in the web site.

e-mail: molecbiol@med.unideb.hu

Department of Physiology

Subject: **HUMAN PHYSIOLOGY I.**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture:

Introductory remarks

Humoral regulation of cell function

2nd week:

Lecture:

Electrical properties of the cell membrane

The mechanism of action potential

3rd week:

Lecture:

Physiology of the body fluids. Liquor. Blood plasma.

Functions of plasma proteins

4th week:

Lecture:

Red blood cells, white blood cells. Blood types.

Hemostasis

5th week:

Lecture: Electrophysiology of cardiac cells

Self Control Test

6th week:

Lecture:

Mechanics and contractility of cardiac cells

The cardiac cycle, regulation of cardiac output

7th week:

Lecture:

Principles of hemodynamics, arterial circulation and microcirculation

Regulation of MAP I.

8th week:

Lecture:

Regulation of MAP II.

Regulation of circulation of specific organs

9th week:

Lecture: Functions of endothelium

Self Control Test

10th week:

Lecture:

Mechanics of respiration

Control of breathing

11th week:

Lecture:

Physiology of the gastrointestinal tract I

Physiology of the gastrointestinal tract II

12th week:

Lecture:

Food intake and its regulation

Energy balance

13th week:

Lecture:

Regulation of striated muscle contraction

Smooth muscle physiology

14th week:

Lecture: tutorial

Self Control Test

Requirements

1. Verification of the semester

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 elearning.med.unideb.hu website (Department of Physiology menu item).

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 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:

score	mark
0 – 59 %	fail
60 – 69 %	pass
70 – 79 %	satisfactory
80 – 89 %	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 50%. 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: **28**

Seminar: **9**

1st week:

Lecture: 1. Introduction. Electromagnetic waves, the properties of light (interference, photoelectric effect, photon theory). Matter waves. Thermal radiation.
2. Generation and absorption of X-ray, X-ray crystallography.

2nd week:

Lecture: 3. Molecule spectra, Jablonski diagram,

fluorescence, fluorescence applications.

4. Sedimentation and electrophoresis. Mass spectrometry.

3rd week:

Lecture: 5. Optics, optical microscopy, electron microscopy.

6. Lasers and their application in biology and medicine.

4th week:

Lecture: 7. Physical properties of sound, ultrasound. Doppler effect. Medical and biological 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, diagnostic and therapeutic application of isotopes. Accelerators.
12. Basic principles of nuclear magnetic resonance, NMR spectroscopy in biology and medicine.

Seminar: From the 6th week onwards, there is a 1-hour seminar per week, where the topics of the lectures are discussed in the form of consultation.

7th week:

Lecture: 13. Principles of tomographic methods. X-ray absorption CT. PET.
14. Magnetic resonance imaging (MRI). Gamma camera, SPECT, PET.
Seminar: Consultation.

8th week:

Lecture: 15. Chemical potential. Brownian motion. Diffusion at the molecular level, statistical interpretation. Fick's laws. Osmosis.
16. The structure of biological membranes. Membrane transport.
Seminar: Consultation.

9th week:

Lecture: 17. Thermodynamic equilibrium potentials (Nernst, Donnan). Diffusion potential, Goldman-Hodgkin-Katz equation.
18. Resting potential, action potential, and electrical excitability. Measurement of membrane potential.
Seminar: Consultation.

10th week:

Lecture: 19. Ion channels (gating, selectivity), the "patch clamp" technique.
20. The physical background of ECG and EEG.
Seminar: Consultation.

11th week:

Lecture: 21. The human ear. Mechanism of hearing. The Weber-Fechner law.
22. The human eye. Photoreceptors. The molecular mechanism of vision.
Seminar: Consultation.

12th week:

Lecture: 23. Biomechanics.
24. Fluid mechanics, blood circulation.
Seminar: Consultation.

13th week:

Lecture: 25. Biophysics of respiration.
26. Flow cytometry. Confocal laser scanning microscopy.
Seminar: Consultation.

14th week:

Lecture: 27. Modern microscopic techniques (atomic force microscopy, super resolution microscopy)
28. Research in the Institute.
Seminar: Consultation.

Requirements

Subject: BIOPHYSICS
Year, Semester: 1st year/1st semester
Number of teaching hours:
Lecture: 28
Subject code: AO_MBE_BIF01
ECTS Credit: 3

CHAPTER 10

Department: Department of Biophysics and Cell Biology, Biophysics Division

Semester recommended to take: 1st year 1st semester.

Semester for the regular course: 1st.

Prerequisites of the course: No prerequisites.

Course coordinator: Dr. Andrea Dóczy-Bodnár

Teaching staff: Prof. Dr. Péter Nagy and the members of the Department

Educational manager: Enikő Nizsalóczki (The location and time of office hours are posted on the website.)

E-mail: biophysedu@med.unideb.hu

Aim of the course: To provide the necessary theoretical background for the understanding the physical principles applied in molecular biology, cell biology and medicine and for the description of the role of physical processes in living organisms (e.g. diffusion, electric properties of cells, etc.). Introduction to (bio)physical methods used in molecular and cell biology as well as in medicine (e.g. flow cytometry, microscopy methods, etc.)

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:

- Introduction to natural sciences (e.g. basic principles of atomic and nuclear physics)
- Physical principles of methods applied in molecular and cell biology (e.g. electrophoresis, sedimentation, mass spectrometry, microscopy, etc.)
- Medical physics (e.g. physical principles of diagnostic and therapeutic procedures)
- Molecular biophysics (e.g. diffusion, membrane biophysics)
- Organ biophysics (e.g. vision, hearing, circulation)

Compulsory reading:

- Educational material (lecture slides, textual explanations of lectures (“booklet”) and exercises) uploaded to the educational website (e-Learning site) of the Department;
- Medical Biophysics textbook (3rd revised edition. Editors: S. Damjanovich, J. Fidy, J. Szöllösi, Medicina, Budapest, 2019, ISBN: 978-963-226-127-0).

Web page of the Department: <http://biophys.med.unideb.hu/en> and the link to the Moodle (e-Learning) within.

Exam: Oral exam during the exam period after the 1st semester. Students who attended the course and were granted with signature in a previous semester can take the exam in the 2nd semester as well, in the frame of the exam course (see Requirements, point 9).

Requirements

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: From the 6th week onwards there is a 1-hour seminar per week, where the topics of the lectures are discussed in the form of consultation. Students are encouraged to ask questions related to the topics of the lectures discussed.

Attendance to seminars is compulsory, however, a student may miss maximum 4 (four) classes.

Based on demand, the seminars can be held in 3-hour blocks (two of the blocks scheduled to the weeks preceding the mid-semester SCTs (see point 5) and one block scheduled to the last week of the semester). If the seminars are held in blocks, a student may miss only one block.

3. 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.

4. Conditions for the signature: the student missed 4 or fewer classes (if there is a one-hour seminar per week) OR maximum one block (if the seminar is held in 3-hour blocks).

5. 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 (X_{ave}). Missed SCTs cannot be made up at a later time.

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

55-64.99: pass (2)

65-74.99: satisfactory (3)

75-84.99: good (4)

85-100: excellent (5)

Only those students are eligible for the offered grade, who completed both SCTs and achieved at least 50% in each case.

Those students who achieved at least 40% in both SCTs are exempted from Part I (minimum requirement questions) of the Final Examination (see point 6).

6. 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 (or in the summer exam period for students registered for the exam course, see point 9). Students are exempted from the FE exam if the grade offered based on the self-control tests is accepted by the student (see point 5.).

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.

Those students who achieved at least 40% in both SCTs are exempted from Part I of the Final Examination (see point 5).

Part II. Oral exam. 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.

Those student who were offered satisfactory (3) or good (4) on the basis of their SCT results (see point 5), but did not accept the offered grade, should only answer one question in the oral exam.

7. Rules for the usage of calculators 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.

8. Information for repeaters

- repeating the course means attending the lectures and the seminars (see points 1 and 2);
- according to the relevant rules (point 5) 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;
- exemptions obtained in the failed semester or the exam period of the failed semester are lost.

9. Information for Exam Course students

Only those students may register for the exam course who attended the Biophysics Lecture course in a previous semester and were granted with signature. Points 1-5 and 8 are irrelevant. Point 6 and 7 applies fully. If an exemption from writing part I of the Biophysics final exam (minimum requirement questions) has been obtained based on the SCT averages, this exemption is also valid for the exam course taken in the same academic year. Every other student must write the minimum requirement questions, even those who passed this part of the exam in a previous exam period. If a student passes the minimum requirement questions in the exam course, he/she will be exempted from taking this part again in the same exam period. The grade offered on the basis of SCT results could only be accepted in the 1semester, it cannot be used in the exam course. Exam topics: all the material covered in the semester immediately preceding the semester in which the exam course is taken.

For further information and news, check the web site of the Department (biophys.med.unideb.hu) and the link to the Moodle (e-Learning) within.

Division of Nuclear Medicine and Translational Imaging

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE PRACTICAL**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Practical: **14**

10th week:

Practical: Half life and gamma spectrum

11th week:

Practical: Labelling 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.

There will be 5 blocks of the practicals.

5x3 hours

Further info: <http://elearning.med.unideb.hu/course/view.php?id=1248>

Subject: **RADIOISOTOPE TECHNIQUES IN BIOMEDICINE**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture: Introduction: radioisotopes in biomedicine. Decay modes, interactions of radiation with matter

2nd week:

Lecture: Detection of radiation: scintillation, gas ionisation

3rd week:

Lecture: General safety regulations, rules of working with radioisotopes. Compulsory before practices!

4th week:

Lecture: Settings for scintillation measurements
1st test: Radioactivity, interactions, detection

5th week:

Lecture: Basic terms and devices of dosimetry. Dose limits.

6th week:

Lecture: "In vitro" isotope diagnostics

7th week:

Lecture: Biological effects of radiation

8th week:

Lecture: "In vivo" nuclear medicine.
2nd test: Radiation protection, "in vitro" diagnostics

9th week:

Lecture: Experimental error calculations, error propagation

10th week:

Lecture: Analytical methods with radiotracers. Characteristics and quality control of radiopharmaceuticals

11th week:

Lecture: Labelling techniques, autoradiography

12th week:

Lecture: Analysing receptor binding and kinetics
3rd test: Labelling, calculations, imaging

13th week: Lecture: Students' presentations	Review and summary
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 labelling techniques, analyzing receptor binding and kinetics, molecular biology.

Further info: <https://elearning.med.unideb.hu/course/view.php?id=1248>

Department of Biochemistry and Molecular Biology

Subject: **BIOINFORMATICS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

1st week: Lecture: 1-2. History of bioinformatics, Primary databases	program package
3rd week: Lecture: 3-4. Secondary and derived databases	11th week: Lecture: Multiple alignments, phylogenetics
5th week: Lecture: 5-6. Searching in database annotation, bioinformatics portals. The UNIX operating system	12th week: Lecture: 12-13. Genomics 1: NGS, <i>denovo</i> genome assembly, genome annotation, ENSEMBL, UCSC Genomics 2: Genome re-sequencing, bioinformatics of RNA-seq and ChIP-seq
7th week: Lecture: 7-8. Similarity search: pairwise alignments, database search	14th week: Lecture: Transcriptomics: searching for and analysis of the TFBSs, GEO, Arrayexpress
9th week: Lecture: 9-10. Structural bioinformatics. Sequence analysis programs, the EMBOSS	

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 <https://elearning.med.unideb.hu> web site, login with your university network ID and password). Students may take one improvement exam per exam period.

Subject: **BIOINFORMATICS PRACTICALS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **14**

2nd week:

Practical: Annotation introduction, ORF Finding, Blast

3rd week:

Practical: Protein domain finding, Multiple alignment

4th week:

Practical: Phylogenetic analysis

5th week:

Practical: Complete sequence analysis, "understand the result". Overview. Writing the report.

6th week:

Practical: Practical assignment analysis.

14th 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: **28**

Seminar: **14**

Practical: **14**

1st week:**Lecture:** Tumor metabolism**2nd week:****Lecture:** Model organisms**Seminar:** The previous week's lecture topic**Practical:** Polymerase chain reaction - basics of experimental design and optimization.**3rd week:****Lecture:** Gene expression I**Practical:** PCR primer design 1. Detection of alternative splice variants. Identify and download the target sequence from the Ensembl database.

Primer design with the Primer3+ program.

Quality control: IDT Oligoanalyzer program.

4th week:**Lecture:** Gene expression II**Practical:** PCR primer design 2. Design of composite primers for directional cloning.**5th week:****Lecture:** Signal transduction I**Practical:** PCR primer design 3. Primer design for site directed mutagenesis. Identification of potential miRNA binding sites with the Targetscan program. 3' UTR sequence download from the UCSC Genome Browser database.**6th week:****Lecture:** Signal transduction II**Practical:** PCR primer design 4. Design of sequencing primers.**7th week:****Lecture:** Cell proliferation I**Practical:** Independent work and report writing**Self Control Test (Topics for week 1-6.)****8th week:****Lecture:** Cell proliferation II and apoptosis**Practical:** Independent work and report writing**9th week:****Lecture:** Stem cells**Practical:** Independent work and report writing**10th week:****Lecture:** Haemostasis**11th week:****Lecture:** Molecular medicine**Self Control Test (Topics of weeks 7-10)****12th week:****Lecture:** Protein turnover and autophagy**13th week:****Lecture:** Noncoding RNAs**14th week:****Lecture:** Summary**Self Control Test (Topics of weeks 11-13.)**

Requirements

Content of Organ and Cell Biochemistry:

Topics presented at the lectures and discussed during the seminars (available at the <https://elearning.med.unideb.hu> web site, login with your university network ID and password). 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 practical. Only one unexcused absence is accepted from the practicals, and three absences are accepted from the seminars. Students will also have to submit the written report of their independent practical work in time. In case of more absences or missed report submission students will not be permitted to take the written exam.

Self-control tests: (not obligatory) During the semester students may choose to write 3 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 3 tests a total of maximum 70 points can be collected. If the combined score of the 3 tests is above 60% of the total score, grades will be offered at the end of semester.

Grading: 2 (pass) 42-48 points, 3 (satisfactory) 49-55 points, 4 (good) 56-62 points, 5 (excellent) 63-70 points.

Grading: Grades will be offered based on the combined score of the self control tests, or based on the score of the written examination during the exam period. The written exams also consist of single-choice and multiple-choice test questions - a maximum of 100 points can be collected. The student's performance will be assessed on a five-grade scale. Pass (grade 2): 60-69 points; satisfactory (grade 3): 70-79 points; good (grade 4): 80-89 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: **28**

Seminar: **28**

1st week:

Lecture: General informations. Introduction into the main topics of plant molecular biology.

Seminar: Discussion of seminar topics.

2nd week:

Lecture: The dynamic plant cell. The coordination between ER and microtubules for the concerted functioning of plant cell. Dynamics of organelles, with special emphasis on vacuoles.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell dynamics. Students present selected topics of this subject on the basis of scientific papers.

3rd week:

Lecture: Organization of nuclear and organellar genome, particularities of transcription and translation in plants. Special plant proteins. Biotechnological aspects.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the

study of plant molecular genetics. Students present selected topics of this subject on the basis of scientific papers.

4th week:

Lecture: Gene regulation in plants, with special emphasis on light-regulated expression. Post-transcriptional and post-translational regulation in plants.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant gene regulation as well as post-transcriptional and post-translational regulations. Students present selected topics of this subject on the basis of scientific papers.

5th week:

Lecture: Particularities of the organization of plant cytoskeleton. Cell cycle regulation in plants.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cytoskeleton and cell cycle

regulation. Students present selected topics of this subject on the basis of scientific papers.

6th week:

Lecture: Photoreceptors: phytochromes, blue and UV receptors. Signal transduction events in photomorphogenesis. Regulation of gene expression by phytochromes. Chronobiology in plants.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of photomorphogenesis. Students present selected topics of this subject on the basis of scientific papers.

7th week:

Lecture: Electron transport proteins in photosynthesis. Short characterization of the Calvin cycle. Molecular/ gene regulation of C- and N metabolism in plants.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of C- and N metabolism in plants. Students present selected topics of this subject on the basis of scientific papers.

8th week:

Lecture: Signal transduction events mediated by plant growth regulators, with special emphasis on auxins. Functions of PIN proteins (auxin efflux carriers).

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant hormone mediated signal transduction and auxin transport. Students present selected topics of this subject on the basis of scientific papers.

9th week:

Lecture: Molecular mechanisms of embryo and root development, the role of plant growth regulators.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of shoot and flower development. Students present selected topics of this subject on the basis of scientific papers.

10th week:

Lecture: Molecular mechanisms of shoot and flower development, the role of plant growth regulators. Flower identity genes: the role of MADS box (homeotic) genes, analogies with homeobox genes-regulated developmental processes in animals.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of shoot and flower development. Students present selected topics of this subject on the basis of scientific papers.

11th week:

Lecture: Plant responses to abiotic and biotic stresses. The formation of reactive oxygen species. Antioxidant systems and metabolites in plants.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant stress responses. Students present selected topics of this subject on the basis of scientific papers.

12th week:

Lecture: Molecular mechanisms of senescence and plant cell death in plants. Plant-pathogen interactions, the hypersensitive response.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant cell death. Students present selected topics of this subject on the basis of scientific papers.

13th week:

Lecture: Secondary metabolism in plants, their synthesis.. Terpenoids, alkaloids, phenoloids, polyketides.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the study of plant secondary metabolism. Students present selected topics of this subject on the basis of scientific papers.

14th week:

Lecture: Functions, effects of special plant metabolites. Allelopathy.

Seminar: Discussion of the topics presented at the lecture. Modern techniques related to the

study of plant special metabolites. Students present selected topics of this subject on the basis of scientific papers.

Requirements

An optional pre-exam is available, if a request is sent to the lecturers.

Exams will be written exams carried out online through the E-learning system, or in person, depending on the situation. Students will have to answer both simple tests and essay questions. The topics of exam will follow those of the lectures and seminars.

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 analyses 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 Foreign Languages

Subject: **HUNGARIAN LANGUAGE II.**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **40**

1st week:

Practical: Revision

2nd week:

Practical: Introducing yourself, registration form, expressing *like doing something, a lot - a*

little, dialogue in a café, conjugation of verbs

3rd week:

Practical: Regular verbs in plural, sights and buildings, buying ice-cream and refreshments, buying an entrance ticket

4th week:

Practical: Different means of transport, conjugation of verbs, the ending *-val/-vel*, something, somewhere, the conjugation of *come / go / be*

5th week:

Practical: *This / this is / this is a/an*, orientation, shops and stores, ordering the conjugation of *eat and drink, do you feel like?, there is no / there are no*

Self Control Test (Mid-term test)

6th week:

Practical: Understanding a chat, question words,

invitation, connectives: *because, but, and, if, or*, buying a cinema ticket, *what number?, which one in order?*

7th week:

Practical: Timetable, *where ... to?*, the ending *-ra/-re*, not ... but, the future: *will be*

8th week:

Practical: Where ? *-n/-on/-en/-ön*, at the market, at the bakery, at the post office

9th week:

Practical: *Where ... from?, -ról/-ről, where?, where ... to?*, dialogue in a taxi, buying a train ticket, prefixes: *be-, ki-, le-, fel-, vissza-*

10th week:

Practical: Revision

Self Control Test (End-term test (written and oral))

Requirements

Attendance

Attending language classes is compulsory. If a student is late it is considered as an absence. Students can miss only 10 percent of the classes that is maximum 2 occasions.

The teacher evaluates active participation in each class. Students are not supposed to share coursebooks in the classes therefore if they fail to bring the coursebook to the class for the second time the attendance is refused.

Testing, evaluation

In each Hungarian language course, students must sit for 2 written language tests and an oral exam. Students must appear at the lecture hall at least 15 minutes before the exam. If students are late, they are not allowed to write the test.

A further minimum requirement is the knowledge of 200 words per semester divided into 10 word quizzes. There are five word quizzes before and another five after the midterm test. If a student fails or misses any word quizzes he / she cannot take the written test. A word quiz can be postponed by a week and students can take it only with their own teacher. Students can get bonus points (5-5%) by taking two extra quizzes containing 20 sentences each, before the midterm and end term tests. The sentences are taken from the units of the coursebook.

The oral exam consists of a role-play from a list of situations covered in the coursebook. If students fail the oral exam, they fail the whole course. The results of the written tests and the oral exam are combined and averaged.

Based on the final score the grades are given as follows.

Final score

0-59

Grade

fail (1)

60-69	pass (2)
70-79	satisfactory (3)
80-89	good (4)
90-100	excellent (5)

If the final score of the written tests is below 60, the student can take a written remedial exam once covering the whole semester's material.

Coursebook: See the website of the Department of Foreign Languages: ilekt.med.unideb.hu. Audio files to the course book, oral exam topics and vocabulary minimum lists are also available on the website.

Department of Medical Chemistry

Subject: **METHODS IN MOLECULAR BIOLOGY PRACTICALS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **46**

1st week:

Practical: 1. Genotyping: DNA preparation, PCR, Agarose gel electrophoresis
2. Investigation of gene expression: Cell culturing, RNA preparation, measurement of RNA concentration, RT reaction, PCR, Agarose gel electrophoresis
3. DNA cloning: Cultivation of *E. coli*, Preparation of competent cells, Ligation, Transformation, Detection of GFP
Demonstration: Quantitative PCR

Extraction of proteins, SDS-PAGE, Western blotting
5. Purification of recombinant GFP by affinity chromatography
6. Plasmid mini-preparation: Preparation of DNA, Restriction analysis, Agarose gel electrophoresis
7. Detection of antigens from blood: ELISA
8. Immunocytochemistry: Isolation, labelling and microscopic analysis of cells

2nd week:

Practical: 4. Investigation of proteins:

Requirements

The successful completion of the exercises and the presence of the students at the demonstration will be acknowledged by the signature of the instructor. In the absence of these signatures the course will not be accepted. In case of justified absence the instructor offers one chance to make up the missed practical class.

The work of the student will be evaluated based on the notebook prepared by the student independently during the practical classes. The practical grade may be improved once, by upgrading/rewriting the notebook.

Textbook:

J. Sambrook, E. F. Fritsch, T. Maniatis: Molecular Cloning, A laboratory manual, 3rd edition, Cold Spring Harbor Laboratory Press, 2001

Teaching materials: web site.

e-mail: molecbiol@med.unideb.hu

Department of Medical Microbiology

Subject: **PHYSIOLOGY OF PROKARYOTES AND MOLECULAR VIROLOGY**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

Practical: **14**

1st week:

Lecture: Structure and taxonomy of viruses.
Virus replication.

2nd week:

Lecture: Replication strategies of viruses.

3rd week:

Lecture: Pathogenesis of viral infections

4th week:

Lecture: 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.

7th week:

Lecture: Antiviral treatment. Prions.

8th week:

Lecture:
Bacterial cell structure. Propagation of bacteria.

Practical:

Propagation of bacteria. Macroscopic, microscopic morphology.

Demonstration:

Bacteria on solid media

Staphylococcus aureus

α -haemolytic Streptococcus

Bacillus subtilis

Escherichia coli

Klebsiella p.

Proteus mirabilis

Pseudomonas aeruginosa

2. Stained smears.

Working task:

1. Preparing smear from bacterial cultures. Gram staining of smears. (*Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*)

2. Examination of macroscopic morphology

3. Microscopic examination of bacteria

4. Culturing of *Escherichia coli*

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 hydrolysis (BEA medium):

Enterococcus faecalis

indol test: *E. coli*, *Klebsiella sp.*

e. ureum hydrolysis test: *E. coli*, *Klebsiella sp.*

f. phenylalanin-deaminase test: *Proteus sp.*, *E. coli*

g. Oxidase reaction: *Pseudomonas sp.*, *E. coli*

h. Catalase test: *S. aureus*, *E. faecalis*

i. 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. Catalase test: *S. aureus*, *E. faecalis*
 6. Coagulase test: *S. aureus*, *S. Epidermidis*
 7. Culturing of bacteria (*E. coli*) for antibiotic sensitivity test

3rd day:

Antibiotic sensitivity tests. Serological reactions.

Demonstration:

ELISA, Western-blot.

Working task:

VDRL

Slide agglutination (*Escherichia coli*)

Validation and interpretation of ELISA, Western-blot

Evaluation of antibiotic sensitivity test.

9th week:

Lecture: Prokaryotic genome. Bacterial DNA replication. Plasmids, transformation of bacteria

Practical:

4th day: Propagation of viruses (animals, embryonated egg, cell cultures)

Working task:

Inoculation of embryonated egg with “virus”

5th day: Propagation of viruses

Harvesting and freezing the chorioallantoic fluid (“virus solution”) from the infected embryonated eggs.

6th day: Direct and indirect detection of viruses, viral infections

Demonstration:

Haemagglutination inhibition.

Working task:

Haemagglutination. Calculation the haemagglutination titer.

10th week:

Lecture: Prokaryotic transcription and translation. Regulation of gene expression in prokaryotes.

Practical: 2nd week practice:

4th day: Propagation of viruses (animals, embryonated egg, cell cultures)

Working task:

Inoculation of embryonated egg with “virus”

5th day: Propagation of viruses

Working task:

Harvesting and freezing the chorioallantoic fluid (“virus solution”) from the infected embryonated eggs.

6th day: Direct and indirect detection of viruses, viral infections

Demonstration:

Haemagglutination inhibition.

Working task:

Haemagglutination. Calculation the haemagglutination titer.

11th week:

Lecture: Photosynthesis of bacteria. *Chemolithotrophic bacteria*. *Bacterial catabolism*. *Archea*.

12th week:

Lecture: Pathogenicity, virulence. Mechanisms of secretion.

13th week:

Lecture: Control of microbial growth I. Sterilization, disinfection

14th week:

Lecture: Control of microbial growth II. Antibacterial therapy

Requirements

The program consists of lectures and laboratory practices. Attendance at laboratory practices and lectures is recorded. Students should attend 100% of laboratory practices. 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 below 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, B and C chance) consists of essay questions. In case of failed results based on the written part of the C chance, the examination continues with oral examination. The examination rules will be announced during the semester.

Compulsory literature:

White D.: The Physiology and Biochemistry of Prokaryotes, 4th edition, Oxford University Press, 2011

Dimmock, N., Easton, A., Leppard, K: Introduction to Modern Virology, 7th edition, Wiley-Blackwell, 2016

Recommended literature:

Christopher Burrell Colin Howard Frederick Murphy : Fenner and White's Medical Virology (Fifth Edition), Academic Press, 2017

Department of Physiology

Subject: **HUMAN PHYSIOLOGY II.**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture:

Principles of renal morphology and renal function

Quantitative description of renal function

2nd week:

Lecture:

Mechanism and regulation of glomerular filtration

Tubular transport processes

3rd week:

Lecture:

Osmoregulation, water balance, diuretics

Defense of body fluid volume, sodium balance

4th week:

Lecture:

Acid-base balance and acid-base disturbances

Potassium balance, micturition

5th week:

Lecture: General principles of endocrinology.

Self Control Test

6th week:

Lecture:

Pituitary gland, growth hormone

The hormones of thyroid gland

7th week:

Lecture:

The hormonal regulation of basal metabolic rate

Male, Female gonadal functions

8th week:

Lecture:

Pregnancy, lactation

The hormones of adrenal cortex

9th week:

Lecture:

The hormones of adrenal medulla, stress

The hormones of pancreatic islets

10th week:

Lecture: Endocrine regulation of intermediary metabolism

Self Control Test

11th week:**Lecture:**

Calcium balance, physiology of bone
Sensory function of nervous system

12th week:**Lecture:**

Mechanisms of vision, hearing and vestibular
sensation. The taste and olfactory systems
Somatomotor functions and spinal cord reflexes,
proprioceptive and nociceptive reflexes.

13th week:**Lecture:**

Role of brainstem, basal ganglia and cerebral
cortex in motor-coordination.
Cerebral Cortex, Intellectual Functions of the
Brain,

14th week:

Lecture: Learning, memory, speech.

Self Control Test

Requirements

1. Verification of the semester

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 elearning.med.unideb.hu website (Department of Physiology menu item).

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 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:

score	mark
0 – 59 %	fail
60 – 69 %	pass
70 – 79 %	satisfactory
80 – 89 %	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 50% 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: **28**

1st week:

Practical: Investigation of the cardiovascular functions.

2nd week:

Practical: Determination of parameters characterizing the respiratory functions

3rd week:

Practical: Examination of the blood.

4th week:

Practical: Computer aided acquisition and processing of biological signals.

5th week:

Practical: Effects of electrolytes on the uterine smooth muscle function.

6th week:

Practical: Effects of neurotransmitters and hormones on the uterine smooth muscle

function.

7th week:

Practical: Computer simulation of the Frank-Starling-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: Lab exam

Requirements

1. Verification of the semester

Attendance of laboratory practices is compulsory. The signature of the semester 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 semester.

For continuous updates on all education-related matters, please check the elearning.med.unideb.hu web site (Department of Physiology menu item).

2. Evaluation during the semester

Laboratory practical knowledge of the students will be tested at the end of the semester as part of the Lab Exam. As a precondition of attending the Lab Exam, the fully completed Exercise Book (with all the verified topics) must be presented during the Lab Exam.

Students are expected to perform the given experiment on their own and must be familiar with theoretical background also.

If the evaluation of the Lab Exam is 'fail' (1) then the Lab Exam can be repeated once during the exam period. There will be only one date for the improvement of the Lab Exam during the exam period.

Division of Biomathematics

Subject: **BIostatISTICS**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **14**

4th week:

Lecture: Set theory. Random events. Conditional probability, marginalization. Independent events. Descriptive statistics. Measure of center and spread. Set theory. Random events. Conditional probability, marginalization. Independent events. Descriptive statistics. Measure of center and spread.

5th week:

Lecture: Random variables. Distribution function and cumulative distribution function of random variable. Discrete probability distributions: binomial and Poisson-distribution.

6th week:

Lecture: Continuous random variables; probability density function. Normal and standard normal distribution. Statistical design and analysis; sampling, estimation. Central limit theorem.

7th week:

Lecture: Hypothesis testing. Null hypothesis. Statistical significance. One- and two tailed tests. Type I and type II error. The z-test. One sample t-test.

8th week:

Lecture: Paired t-test. F-test. Unpaired t-test.

9th week:

Lecture: Conditional probability in medicine, screening tests. ROC curve. Epidemiologic investigations: odds ratio and relative risk. The Kaplan-Meier curve.

12th week:

Lecture: Biostatistics final test.

Requirements

1. The aim of the course, short description of the subject

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 statistics (set theory, probability, conditional probability). Descriptive statistics (determination of mean, median, mode, standard deviation from data set). Discrete and continuous random variables; binomial, Poisson and normal distributions. Sampling, characterization of samples; unbiased estimate, central limit theorem. Hypothesis testing (z, t, F tests). Screening tests and epidemiologic investigations in medicine. In the classes, students are encouraged to ask questions related to the topic of the lectures discussed.

3. Requirements for the Biostatistics course

Attendance to classes is mandatory. Students must not miss more than one class. No kind of certificates, including a medical certificate, are accepted for the absences. Making up for missed classes is not possible.

4. Requirements for signing the lecture book

Signing of the lecture book is denied if there are more than one absences from group wise classes.

5. Course test

Students will write a grade-offering course test after the last seminar. Writing the grade-offering course test is not compulsory but recommended. The structure of this test will be identical to that of the final exam. A grade of pass (2) or better achieved on the grade-offering test is valid for the final exam.

6. Final exam

Students must take a written exam. Exams will be held once every two weeks during the exam period. The structure of the final exam: theoretical questions (true or false questions, multiple choice questions, fill-in questions, open-ended questions), graphs 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 (1)
- $50 \leq FS < 65$	pass (2)
- $65 \leq FS < 75$	satisfactory (3)
- $75 \leq FS < 85$	good (4)
- $85 \geq FS$	excellent (5)

7. Compulsory reading

Educational material published on the eLearning page of the course can be downloaded in pdf format (elearning.med.unideb.hu – Department of Biophysics and Cell Biology–English Courses–2nd semester).

8. Recommended reading

Wayne W. Daniel: Biostatistics, A foundation for Analysis in the Health Sciences, John Wiley&Sons

9. Exemptions

Applications for exemption from the biostatistics course has to be turned in to the Credit Transfer Committee via the Neptun system or the Educational Office. Such requests are not accepted by the Biomathematics Division or the Department of Biophysics and Cell Biology.

10. Information for repeaters

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

11. 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.

12. Rules for calculator:

Rules for calculator usage during course 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. Sharing calculators during tests is not allowed, and the test proctor will not provide a calculator.

Division of Cell Biology

Subject: **CELL BIOLOGY**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture: Lecture 1: Introduction. Origin of life. Prokaryotes and eukaryotes

Lecture 2: Cell membrane. Membrane transport

Seminar: students are advised to attend the seminars for general medicine. A suitable class can be selected based on the timetables posted on the department website.

1. Introduction, course requirements, safety, FAQ.

2nd week:

Lecture: Lecture 3: ABC transporters and related diseases

Lecture 4: Ion channels, membrane potential

Seminar: Material related to lectures 1-2.

3rd week:

Lecture: Lecture 5: Cell organelles. Overview of intracellular transport processes

Lecture 6: Intracellular membrane systems I: lysosome, peroxisome, endoplasmic reticulum

Seminar: Material related to lectures 3-4.

4th week:

Lecture: Lecture 7: Intracellular membrane systems II: The Golgi complex, endo- and exocytosis, protein sorting

Lecture 8: Nuclear envelope. Transport through nuclear pores

Seminar: Material related to lectures 5-6.

5th week:

Lecture: Lecture 9: Cytoskeleton I: microtubules

Lecture 10: Cytoskeleton II: intermediate filaments, actin cytoskeleton

Seminar: Material related to lectures 7-8.

6th week:

Lecture: Lecture 11: Cell-cell and cell-matrix contacts

Lecture 12: Cellular energetics, mitochondrion

Seminar: Material related to lectures 9-10.

7th week:

Lecture: Lecture 13: Calcium homeostasis

Lecture 14: Osmo-, volume and pH regulation

Seminar: Material related to lectures 11-12.

8th week:

Lecture: Lecture 15: Nucleus, Chromatin

Lecture 16: Cell division cycle

Seminar: Material related to lectures 13-14.

9th week:

Lecture: Lecture 17: Mechanics of the cell cycle

Lecture 18: Regulation of the cell cycle

Seminar: Material related to lectures 15-16.

10th week:

Lecture: Lecture 19: Cell signalling I. General concepts. Nuclear receptors. G-protein coupled receptors

Lecture 20: Cell signalling II. Receptor tyrosine kinases. The Ras/MAPK, PI3K/Akt and PLC/CaMK pathways

Seminar: Material related to lectures 17-18.

11th week:

Lecture: Lecture 21: Cell signalling III. Pathways to the nucleus

Lecture 22: Cell-cell communication in the nervous and the immune system

Seminar: Material related to lectures 19-20.

12th week:

Lecture: Lecture 23: Cell fates. Differentiation.

Lecture 24: Oncogenes. tumor cells

Seminar: Material related to lectures 21-22.

13th week:

Lecture: Lecture 25: Cell senescence, apoptosis

Lecture 26: Stem cells

Seminar: Material related to lectures 23-24

14th week:

Lecture: Lecture 27: From genes to cell function: overview of the main regulatory mechanisms.

Lecture 28: Cell motility

Seminar: Material related to lectures 25-26.

Requirements

Department: Department of Biophysics and Cell Biology, Cell Biology Division

Recommended semester: 1st year 2nd semester.

Prerequisites of the course: No prerequisites.

Teaching staff: Prof. Dr. György Vereb and the members of the Department

Education manager: Enikő Nizsalóczy (e-mail: cellbioedu@med.unideb.hu)

Aims of the course: The course gives an overview of the functional anatomy of higher eukaryotic animal cells with examples of the paradigmatic molecular mechanisms. Students successfully completing the course will have acquired an active professional vocabulary minimally required for studying biochemistry, molecular biology, genetics, histology and physiology. In addition, the course aims to provide a thorough knowledge base which serves to understand the functions and dysfunctions of the human body in their broader context.

Course synopsis: Structure and constituents of eukaryotic cells, the most important cellular functions: membrane transport, vesicular transport, cell signalling, cell division (mitosis, meiosis), differentiation, cell death

Material to be studied:

Compulsory sources: 5th ed. of Essential Cell Biology (Alberts et al., Garland Publ Inc. 2019. ISBN-13:978-0393-6803-62). Chapters 1 and 11 through 20 are studied in depth during the course. Chapters 2 through 10 contain explanations for basic molecular concepts. There is additional core material that is available only in the lectures.

Cell biology Lab Notes: the currently required, up-to-date version is available at the course home page (@ elearning.unideb.hu).

Recommended: The in depth full-text version of the course material can be found in:

Lodish et al.: MOLECULAR CELL BIOLOGY, 7th edition, W. H. Freeman, 2013, ISBN-13: 978-

1-4292-3413-9; Alberts et al.: MOLECULAR BIOLOGY OF THE CELL; 6th edition, Garland Publ. Inc., 2015, ISBN 978-0-8153-4453-7;

The 4th editions of these are also available online:

<http://www.ncbi.nlm.nih.gov/books/NBK21475/>

<http://www.ncbi.nlm.nih.gov/books/NBK21054/>

Knowledge that will be examined in this course is comprised in the slides presented in the lectures. It is recommended to download these slides before the lectures and take notes on them during the lecture. Slides of central importance will be marked accordingly.

Course home page: <https://biophys.med.unideb.hu/en/node/635>

<https://elearning.med.unideb.hu/>

Type of exam: Final exam

Exemptions: In order to get exemption from the complete Cell Biology course, the student has to apply to the Education Office. Applications for exemption from part of the courses are handled by the Department. The deadline for such applications is Monday on the second week of education. No application will be considered after this date. The following documents have to be submitted to the Educational Advisor: 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. Applicants may be interviewed before the decision is made.

Requirements:

1. Lectures: Attendance of lectures is indispensable for acquiring the knowledge required to pass, understanding which parts of the material have the highest importance, and finding the proper sources for preparing for the exam.

2. Seminars: Students should attend the seminars together with those in the General Medicine Course. A suitable class should be selected based on the timetables posted on the department website / eLearning. Students should also make efforts to write SCTs, SOQs and do a presentation in order to get bonuses during the semester.

Seminars serve to discuss the lecture material. Use them well, study the material before the seminar and arrive with your questions. Maximum two absences are permitted. Students must attend the seminars with their assigned study group. Students may sign up for one short inter-active presentation during the semester. The teacher will choose the topics/questions on the spot and the presenter is required to explain the topic. This requires the in depth knowledge of all the topics presented at the lectures and studying the relevant textbook chapters. The presentations are graded on a scale of 0-5. This grade counts toward the bonus points earned during the semester.

3. Labs: Labs are done under a separate subject code and need to be passed for acquiring a signature in for this course.

4. Self-control Tests (SCT-s):

There will be at least two SCT-s. The dates and topics (covering the whole material) for SCT-s are announced in the beginning of the semester. Test and essay questions are scored on a 0-100% scale, averaged for the SCTs (=SCTave) and this average is used for offering exemptions and bonus points

towards the final grade (see 5.2 and 5.4.1.). Similarly to the final exam, basic questions (on minimally required knowledge, part A) and in depth questions (part B) constitute the SCT. As opposed to the final exam, both A and B parts are evaluated in SCTs and contribute to the SCT score regardless of their value.

Writing the SCTs is not compulsory; SCTs cannot be made up for, even in the case of a justified absence. Missed SCTs contribute a score of 0 towards SCT_{ave} .

There will also be short online quizzes (SOQ) at the beginning of each seminar, covering all the material that is scheduled for discussion in the given seminar. The best 10 scores of these SOQs will be averaged (SOQ_{ave}) and converted into bonus points and used when determining offered grades (see 5.4.1).

5. Final Exam (written):

5.1. Parts of the Final Exam. The exam is a written exam of two parts (A and B).

Part A of the written test is a minimum level test. It consists of a set of 10 true-or-false questions about basic cell biology knowledge (1 point each) and 5 questions asking for a brief description of basic terms (molecules, concepts). These terms are listed among the key-words published on the subject's website. The answers are scored on a 0-2 scale in increments of 0.5 points. The student has to score 16 or above out of the total 20 points in part A to pass. Below 16 points the grade of the exam is a fail (1) and part B is not marked. For writing Part A, 20 minutes are allocated. A successful passing of Part A (or exemption from writing Part A, see 5.4.2) is valid for B and C exams throughout the given exam period, but not in consecutive semesters.

Part B is a 90 minute complex exam, including short essays (~20-25% of the total score), fill-in, short answer, multiple choice, relation analysis, sketch-recognition, term-recognition, as well as simple choice and true-or-false questions.

5.2. Calculating the exam score. As per 5.1., exam score is only calculated if Part A is passed.

1. % result of Part B expressed as points, 100 points maximum. If score on Part B is greater or equal to 50%, the following bonus points are added to the score of Part B:

2. Presentation grade, 5 points maximum

3. Average % result of SCTs (SCT_{ave}):

4 points for reaching 30%, +1 for each additional 10% reached, 10 points maximum

Total: 115 points maximum

N.B. Bonuses are only valid in the semester they were obtained.

5.3. Assigning grades to exam scores

Part A below 16 points: fail (1)

Exam score (see 5.2.):

below 60 points: fail (1)

60-69.9 points: pass (2)

70-79.9 points: satisfactory (3)

80-89.9 points: good (4)

reaching, and above 90 points: excellent (5)

5.4. Exemptions

5.4.1. For those who achieve $SCT_{ave} \geq 50\%$ at the self-control tests, a final grade offering score is calculated as follows:

1. SCT_{ave} % expressed as points, 100 points maximum
 2. Presentation grade, 5 points maximum
 3. Result of short online quizzes (SOQ_{ave} , of the 10 best %s cores).
 - 4 points for reaching 30%, +1 for each additional 10%, reached 10 points maximum
- Total: 115 points maximum

Grades are offered as listed under "5.3. Assigning grades to exam scores". (Part A is considered to be passed in this case without writing a Part A test.)

5.4.2. Those who achieve $SCT_{ave} \geq 66\%$ at the self-control tests and do not accept the offered grade calculated as under 5.4.1. and therefore take the final exam, are exempted from Part A of the written final exam during the given semester.

6. Rules for repeating the course

6.1. Repeaters taking again a regular Cell Biology course need to attend seminars and can do presentations as regulated normally (see 2.). We encourage repeaters to write the SCTs since this is the only way to receive bonuses and exemptions based on SCT_{ave} scores.

6.2. Repeaters can apply for a Cell Biology exam course in the third semester if they have taken at least one exam in the previous exam period and in that exam have passed the minimum requirements (Part A), and have scored at least 35% on Part B). The above items 1.-4. and 6.1. are irrelevant to the exam course and consequently no bonuses can be earned during the exam course. Otherwise the final exam proceeds as detailed under 5. If Part A is passed in the exam, the % result of Part B expressed as points is converted to a grade as per 5.3.

CHAPTER 11 REQUIRED ELECTIVE COURSES

Department of Biophysics and Cell Biology

Subject: **CELL ANALYSIS**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Practical: **28**

1st week:

Practical: 1st – 14th weeks:

Practical: In blocks, based on mutual agreement

with the student

Requirements

Department: Department of Biophysics and Cell Biology, Cell Biology Division

Recommended semester: 2nd year 2nd semester.

Prerequisites of the course: Successful exam in the following subjects: Cell Biology Lecture, Cell Biology Practical, Fluorescence-based methods in Life Sciences.

Teaching staff: Prof. Dr. György Vereb and the members of the Department

Education manager: Enikő Nizsalóczki (e-mail: cellbioedu@med.unideb.hu)

Aims of the course: To acquire basic knowledge about the application of various quantitative cell analysis methods used in biomedical research, and the use of the most widely spread instruments. To gain hands-on experience in quantitative cell analysis and strengthen the student's methodological repertoire through this.

Course synopsis: The student joins ongoing research at the Department, and learns the practical aspects of various quantitative cell analysis methodologies through hands-on experience. The most frequently used methods are absorption and fluorescence spectroscopy, conventional transmission and fluorescence microscopy, confocal laser scanning microscopy, slide-based cytometry, flow cytometry, as well as culturing, manipulating and labelling/preparing cells for these measurements. Lab work is in blocks, with timing adjusted to the student's time-table and the schedule of experiments. Maximum 5 students / semester.

Exam: Practical grade

Literature

Alberts et al.: Essential Cell Biology.

5th edition. Garland Public Inc., 2019. ISBN-13:978-0393-6803-62

Cell Biology Practicals, latest version. To be downloaded from eLearning.

Publications related to current research to which the practical is linked.

Other recommended literature:

Lodish et al.: Molecular Cell Biology.

7th edition, W. H. Freeman, 2013.

Alberts et al.: Molecular Biology of the Cell.
6th edition. Garland Publ. Inc., 2015.

Department of Immunology

Subject: **BASIS OF CONVENTIONAL AND BIOLOGICAL IMMUNOTHERAPIES**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Lecture: **30**

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.
- Structure 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: 2nd year/2nd semester

Number of teaching hours:

Lecture: **15**

Practical: **15**

Requirements

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

As the topics of the practicals and the lectures are connected, understanding of the practice topics should be a prerequisite of a successful examination at the end of the semester. Practical notes should be prepared after the practices. The practice note should be submitted to the practice leader before the next practical. 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 evaluation of the course (grading) is based on the results of the quick self-control tests at the beginning of the practices and the quality of the submitted practice notes together with the result of the final large self-control test. This written examination (self-control test) is performed at the first or second week after the final lecture. If this exam is failed (no attendance or the score below the threshold) the grade can be obtained in the exam period by passing a quick written entry test and a subsequent oral test which could involve calculations connected with the practicals.

Attendants who passed their written exam but are discontent with their 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.

Subject: **IMPAIRED SIGNAL TRANSDUCTION IN THE IMMUNE SYSTEM**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Lecture: **15**

Requirements

To follow the progress of students one self control test (SCT) will be organised (Week 12). The SCT contains questions about the material of lectures given between week 8-12.

Students who score an average of 50% 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.elearning.med.unideb.hu).

Lecture materials and other information concerning education can be found on our website at www.elearning.med.unideb.hu.

Subject: **NEW SYSTEM BIOLOGY PARADIGMS IN IMMUNOLOGY**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Seminar: **11**

Requirements

Acquired skills:

This is a formal seminar-discussion course for advanced students focused on recent developments in the field and consisting of literature research and intensive in-depth study of important and timely topics. A particular attention will be given to the biology of unique dendritic cell populations and the mechanisms of viral infections. We will also have detailed discussions on the topics of skin and gut immunology, tumor immunology and the modern immunological aspect of cell death.

Exam form: written exam

During the semester students have to prepare a Power Point presentation and a written summary (maximum 2 pages Word document) based on a scientific publication.

The scientific paper will be defined by the Course Coordinator.

Instructions for the exam:

1. The student shall look for the Course Coordinator:

The student shall send the following information to pazmandi.kitti@med.unideb.hu e-mail address:

-NAME

-NEPTUN CODE

-SPECIALIZATION

and student shall ask for the scientific paper.

2. The Course Coordinator will send an e-mail to the student with the scientific publication.

3. Student has to prepare the Power Point presentation based on the article.

4. Student has to prepare the written summary in a Word document (maximum 2 pages).

5. Student has to send the presentation and the written summary to the Course Coordinator via e-mail for review. The name of the files will be: name of the student and neptune code and specialization (For example: Bruce Willis_I80KL6_MolBiol or GENMED or PhD).

Form of the Power Point 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.

- Structure of the presentation: backgrounds, aims, methods, results and discussion or conclusion including the significances of the work.

-Students have to present all of the Figures from the article and have to indicate the title of the Figures on the slide.

-It is required to indicate the contents of the slides in text format in the text box under the slides or on the slides next to the Figures!

- It is FORBIDDEN to literally copy the text of the scientific article, in which case the Course Coordinator will refuse to evaluate the presentation and, as a result, to complete the subject!

Form of the written summary:

1. The student must summarize the content of the scientific article in the form of a Word document (maximum 2 pages).

2. Formal requirements: Times New Roman 12 point, line spacing:1.5, margins: 2 cm.

3. Please begin the summary with the following information: 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.
4. Structure of the summary: backgrounds, aims, methods, results and discussion or conclusion including the significances of the work.
5. It is FORBIDDEN to literally copy the text of the scientific article, in which case the Course Coordinator will refuse to evaluate the summary and, as a result, to complete the subject!

Department of Medical Chemistry

Subject: **BIOCHEMISTRY PRACTICAL I.**

Year, Semester: 1st year/1st semester

Number of teaching hours:

Practical: **42**

1st week:

Practical:

Laboratory and fire safety instructions. Chemical calculations. Concentration of solutions. Laboratory techniques: laboratory equipments, volumetric apparatus. (Micro)pipetting.

2nd week:

Practical: Ion exchange chromatography. Paper chromatography: separation of food dyes and separation of amino acids. Gel filtration.

3rd week:

Practical: Quantitative analysis. Acid-base titrations: strong acid-strong base, weak acid-strong base titrations. Introducing and using titrators.

4th week:

Practical: Electrometric pH measurement.

5th week:

Practical: Spectrophotometry. Photometric determination of inorganic phosphate. Quantitative protein analysis: Biuret assay. Bradford assay. Assay of glucose. Enzymatic determination of glucose in blood serum.

6th week:

Practical:

Qualitative analysis of mono- and disaccharides. Polarimetric analysis of carbohydrates.

7th week:

Practical: Reaction kinetics. Kinetic study of the saponification reaction of ethylacetate. (Effect of concentration and temperature on the rate.)

8th week:

Practical: Enzyme kinetics. Assay of glycogen phosphorylase activity.

9th week:

Practical: Enzyme kinetics. Assay of catalase activity.

10th week:

Practical: Measuring superoxide anion radical production. Assaying superoxide dismutase (SOD) activity. Detection of radical scavenging compounds (antioxidants) with ABTS decolorization assay.

11th week:

Practical: Identification of proteins using SDS-polyacrylamide gel electrophoresis (PAGE) and Western blot.

12th week:

Practical: Detection of hydroxyl radicals produced in the Fenton's reaction. Effect of metal ion chelator and hydroxyl radical scavenger compounds.

13th week:

Practical: Photometric determination of iron.
Detection of nitric oxide production by macrophage cells (Griess assay).

14th week:

Practical: Practical exam.

Requirements

The program consists of laboratory practices. Attendance at laboratory practices is recorded. Students should attend at all the laboratory practices. Upon approval by the laboratory teacher, missed and not accepted practices can be made up by the students on the same week or the next week (if the missed lab is still running). Students will be graded by laboratory practical tests written on the practicals and will be assessed as follows*:

Percentage (%)*	Mark
0-56	fail (1)
57-65	pass (2)
66-75	satisfactory (3)
76-84	good (4)
85-100	excellent (5)

Subject: **SIGNALLING PATHWAYS IN THE CELLS**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Lecture: **28**

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.

6th week:

Lecture: Off mechanisms

7th week:

Lecture: Spatial and temporal aspects of signalling

8th week:

Lecture: Cellular processes

9th week:

Lecture: Development

10th week:

Lecture: Cell cycle and proliferation

11th week:

Lecture: Cell stress, inflammatory responses and cell death

12th week:

Lecture: Neuronal signalling

13th week:

Lecture: Signalling defects and diseases

14th week:

Lecture: Students' presentations: novel mechanisms in signaling

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.

Department of Medical Microbiology

Subject: **HUMAN PATHOGENIC BACTERIA**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture: Gram-positive cocci: Staphylococci
Streptococci

2nd week:

Lecture: Gram-positive spore-forming rods:
Bacillus, Clostridium

Non-spore forming anaerobes: *Gram-positive:*
Peptococcus, Peptostreptococcus, Actinomyces,
Lactobacillus, Eubacterium, Propionibacterium;
Gram-negative: Veillonella, Bacteroides,
Fusobacterium, Prevotella, Porphyromonas

3rd week:

Lecture: Gram-positive non spore forming rods: Corynebacterium, Listeria, Erysipelothrix, Gardnerella, Mycobacterium

4th week:

Lecture: Enterobacteriaceae I: Escherichia, Salmonella, Shigella, Klebsiella, Enterobacter, Serratia, Proteus, Morganella, Providencia, Citrobacter

5th week:

Lecture: Enterobacteriaceae II:
Campylobacter, Helicobacter, Vibrio, Yersinia

6th week:

Lecture: Gram-negative cocci: Neisseria, Branhamella,
Gram-negative coccobacilli: Haemophilus, Bordetella, Francisella, Brucella, Moraxella, Pasteurella

7th week:

Lecture: Gram-negative non fermenting rods:
Pseudomonas, Burkholderia, Acinetobacter, Stenotrophomonas, Alcaligenes

8th week:

Lecture: Spirochaetes: Treponema, Borrelia, Leptospira

9th week:

Lecture: Obligate intracellular bacteria:
Rickettsia, Coxiella, Bartonella, Chlamydia
Cell wall free bacteria: Mycoplasma

Others: Legionella

10th week:

Lecture: STD, atypical pneumonia

11th week:

Lecture: Zoonotic diseases

12th week:

Lecture: Nosocomial and opportunistic infections

13th week:

Lecture: Transplacentally transmitted infections, food poisoning

14th week:

Lecture: Meningitis

Requirements

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

The aim of this course is to provide differentiated professional knowledge and skill about bacteriology. Students will study about newest results of bacteriology and they will be able to use their skills in practice.

Topics:

Gram-positive cocci: staphylococci, streptococci; Gram-positive spore-forming rods: Bacillus, Clostridium; Gram-positive, anaerobic, non spore-forming bacteria: Peptococci, Peptostreptococci, Actinomyces, Mobiluncus, Bifidobacterium, Lactobacillus, Eubacterium, Propionibacterium; Gram-negative, anaerobic, non spore-forming bacteria: Veillonella, Bacteroides, Fusobacterium, Prevotella, Porphyromonas, Leptotrichia; Gram-positive, non spore-forming bacteria: Corynebacterium, Listeria, Erysipelothrix, Gardnerella, Mycobacteria, Nocardia; Enterobacteriaceae I: E. coli, Salmonella, Shigella, Klebsiella, Enterobacter, Serratia, Proteus, Morganella, Providencia, Citrobacter; Enterobacteriaceae II: Campylobacter, Helicobacter, Vibrionaceae, Aeromonas, Pateruella, Yersinia; Gram-negative cocci: Neisseria, Moraxella; Gram-negative coccobacilli: Haemophilus, Bordetella, Francisella, Brucella; non fermenting Gram-negative rods: Pseudomonas, Burkholderia, Acinetobacter, Stenotrophomonas, Alcaligenes; Spirochetes: Treponema, Borrellia, Leptospira; obligate intracellular bacteria: Rickettsia, Coxiella, Bartonella, Chlamydia; Mycoplasma

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.

Signature of the lecture book:

The Department may refuse to sign the students' lecture book if they are absent from more than one practice in a semester.

Examination:

Practical exam: Written test at 15th week consists of five diagnostical assay questions (five grade scale).

Three mid-semester tests are written during the semester. 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 sit for 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 an oral examination. A list of questions and the examination rules will be announced during the semester.

Subject: **HUMAN PATHOGENIC BACTERIA PRACTICALS**

Year, Semester: 2nd year/1st semester

Number of teaching hours:

Practical: **14**

1st week:

Practical: catalase test, coagulase test, detection of clumping factor, slide agglutination, CAMP test, bile test, optochin sensitivity, recognition of different types of hemolysis and colony

morphology on blood agar and chocolate agar

2nd week:

Practical: Gram staining, spore staining, anaerobic culture techniques, lecithinase test,

evaluation of rapid automatic tests, recognition of colony morphology on selective anaerobic media, usage of anaerobic chamber

3rd week:

Practical: Elek-test, API Listeria test, Ziehl-Neelsen staining, recognition of colony morphology on Löwenstein-Jensen media

4th week:

Practical: recognition of colony morphology on eosin-methylene blue, XLD media, biochemical reactions (oxidase, indole, urease, methyl red, Voges-Proskauer reaction, citrate, TSI, fenilalanine deaminase test)

5th week:

Practical: recognition of colony morphology on CCDA and TCBS media, evaluation of ID32E automatic identification, biochemical reactions (catalase, oxidase), urea breath test

6th week:

Practical: recognition of colony morphology on specific culture media (modified Thayer-Martin), biochemical reactions (oxidase), satellite phenomenon, evaluation of API NH test

7th week:

Practical: recognition of colony morphology on nutrient and eosine-methylene blue agar, biochemical reactions (oxidase, OF), evaluation of Kirby-Bauer disk diffusion test, determination of minimal inhibitory concentration by E-test, Hodge-test, evaluation of ID32 GN automatic identification

8th week:

Practical: serological methods (agglutination, precipitation, ELISA, Western-blot, complement fixation)

9th week:

Practical: indirect immunofluorescence, evaluation of immunochromatography, evaluation of mycoplasma and ureaplasma identification kits, collection of specimens

10th week:

Practical: visiting of the bacteriological diagnostical laboratory

Requirements

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

The aim of this course is to provide experiences in the laboratory practice.

Topics:

Topics are related to the theoretical course and cover the practical knowledge about the diagnostic procedures in the bacteriology

Text book:

Warren Levinson: Medical Microbiology and Immunology. Edition by Appleton and Lange

Requirements:

The students are required to attend the lectures and practices.

Signature: The Department may refuse to sign the students' lecture book if they are absent from more than two practices in a semester.

Examination: end-semester examination and practical exam. Students are required to take the end-semester examination (EE), based on the whole material taught in Humanpathogenic bacteria. The student's test will be assessed on a five-grade scale. The FE consists of a written test with simple choice, multiple choice and assay questions. The passing level is 60 %. The practical exam consists of five diagnostical assay questions (five grade scale).

those who are not satisfied with the grade or are below the passing level, should sit for another end-

semester-examination hold in the examination period.

Subject: **HUMAN PATHOGENIC VIRUSES**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Lecture: **28**

1st week:

Lecture: Influenza viruses.

2nd week:

Lecture: Paramyxoviruses (Parainfluenza, Mumps, Morbilli, RS virus

3rd week:

Lecture: Rubellavirus. Coronaviruses.

4th week:

Lecture: Hepatitis viruses (Hepatitis A, B, C, D, E viruses)

5th week:

Lecture: Herpesviruses (Herpes simplex viruses, Varicella-zoster virus, Cytomegalovirus, Epstein-Barr virus)

6th week:

Lecture: Adenovirus.. Parvoviruses. (B19 parvovirus)

7th week:

Lecture: Picornaviruses (Polio-, Coxackie-, Echo-, Rhinovirus). Reoviridae (rotavirus)

8th week:

Lecture: Poxviridae (Variola, Molluscum

contagiosum). Rhabdoviridae (Rabies virus)

9th week:

Lecture: Slowly developing viral infections (SSPE, PML) . Prions (kuru, Creutzfeldt-Jacob disease)

10th week:

Lecture: Arboviruses (encephalitis viruses, yellow fever, dengue-fever)

11th week:

Lecture: Roboviruses (Hantaan virus, arenaviruses, filoviruses)

12th week:

Lecture: Human tumour viruses (papillomaviruses, oolyomaviruses, HTLV)

13th week:

Lecture: Human immundeficiencia virus (HIV)

14th week:

Lecture: Emerging viruses: SARS, avian influenza, Hendra virus, Nipah virus, Menangle virus.

Requirements

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

The aim of this course is to provide differentiated professional knowledge and skill about virology. Students will learn about the newest results of virology and they will be able to use their skills in research and diagnostics.

Topics:

Respiratory pathogens: adenoviruses, rhinoviruses, human influenza viruses, paramyxoviruses, corona viruses. Enteral viruses: hepatitis viruses, rotaviruses, coxsackie viruses, echoviruses, caliciviruses, astroviruses. Central nervous system pathogens: polyoviruses, rhabies. Viruses which cause rash, lesions: morbilli, mumps, rubella, herpes simplex viruses, human herpesvirus 6, parvovirus, variola. Oncogenic viruses: papillomaviruses, polyomaviruses, molluscum

contagiosum, Epstein-Barr virus, human herpesvirus 8, human T-cell leukemia/lymphoma viruses. HIV and AIDS. Arbo- and reboviruses. Slow viral infections and prions. Emerging pathogens, recently discovered pathogens: SARS, avian influenza, Hendra virus, Nipah virus, Menangle virus.

Requirements:

Two mid-semester tests are written during the semester. 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 below the passing level, should sit for an end- semester-examination (A – chance) hold in the examination period.

Division of Cell Biology

Subject: **CELL BIOLOGY PRACTICE**

Year, Semester: 1st year/2nd semester

Number of teaching hours:

Practical: **15**

2nd week:

Practical: Preparation for labs

3rd week:

Practical: Cell types and basic constituents: separation and staining of blood cells

4th week:

Practical: Cell types and basic constituents: separation and staining of blood cells

5th week:

Practical: Membrane transport: multidrug resistance

6th week:

Practical: Membrane transport: multidrug resistance

7th week:

Practical: Homeostasis: cell viability and death

8th week:

Practical: Homeostasis: cell viability and death

9th week:

Practical: Cell morphology, subcellular structures: fluorescent visualization

10th week:

Practical: Cell morphology, subcellular structures: fluorescent visualization

11th week:

Practical: Cell signalling: in situ observation

12th week:

Practical: Cell signalling and cell division

13th week:

Practical: Remedial lab

14th week:

Practical: Remedial lab

Requirements

Department: Department of Biophysics and Cell Biology, Cell Biology Division

Recommended semester: 1st year 2nd semester.

Semester for the regular course: 1st.

Prerequisites of the course: No prerequisites.

Teaching staff: Dr. Katalin Goda and members of the Department

Education manager: Enikő Nizsalóczki (e-mail: cellbioedu@med.unideb.hu)

Aims of the course: The course gives an overview of the functional anatomy of higher eukaryotic animal cells with examples of the paradigmatic molecular mechanisms.

Material to be studied:

Cell biology Lab Notes: the currently required, up-to-date version is available at the course home page on the eLearning site.

Relevant parts of the Cell Biology Lecture course (see there).

Course home page: <https://biophys.med.unideb.hu>, elearning.med.unideb.hu

Signature: Signing for the course can be denied if the student has not performed all the lab practices or any one of the lab logs has not been accepted.

Type of exam: Practical grade

Requirements:

Completing all labs, and writing up the results and their interpretation in a lab log book on the spot is required. Only handwritten, bound lab log books are acceptable. The compulsory preparation for the lab includes writing the aims of the lab and the methods of implementation into the lab logbook before the lab. During the lab a log must be written into the book in a way that allows reproducing the work done. So it must document what the student has actually done, the results obtained (including graphs and color drawings), and their interpretation. The lab tutor will only sign the log up-on proper, independent completion of the lab All labs must be accepted by a valid signature in order to receive the end of term signature.

Labs can only be performed by students who arrive well prepared. This is checked by a ~10 min test at the beginning of the lab, graded on a scale of 0-5 according to the following table:

Number of correct answers	Test Points (TP)
less than 5	0
5	1
6	2
7	3
8	4
9-10	5

A TP of 0 results automatically in dismissal from the lab.

Furthermore, if the student's participation in the lab is not acceptable, the lab tutor will dismiss the student from the lab immediately, and the lab will be considered failed.

TP ≥ 1 are averaged and, after rounding, yield the final practical grade. If the average of the TP is below 1.5, it results in a practical grade 1 (fail). In these cases, a written lab exam can be done for the pass (2) mark before the exam period (covering the topics of all labs).

The practical grade cannot be improved in the exam period.

Since all labs must be accepted in order to receive the end of term signature (and a practical grade),

those missing a lab are offered one (1) extra occasion to make up for the missed lab during the remedial week. This offer includes both the cases of writing a lab test of grade 0 earlier, and labs missed because of certified illness. In the latter case, certificates must be filed with the Education coordinator in Office Hours at the earliest possible occasion, so the student can be assigned a remedial lab appointment.

Subject: **SELECTED TOPICS IN CELL BIOLOGY**

Year, Semester: 2nd year/2nd semester

Number of teaching hours:

Lecture: **24**

Requirements

Neptun code: AOG157403-K1, ECTS: 2 credit points

Requirement for signature:

- maximum 3 recorded absences total (no make-up possible)

Exam dates: week 13. written exam for receiving the practical grade.

The exam can also be taken during the exam period, but this counts as a first exam after a practical grade of "fail". Check NEPTUN for dates.

Exam type: online test (see below)

Grading:

>50% pass

>60% satisfactory

>70% good

>80% excellent

In order to take an exam of the course "Selected Topics in Cell Biology" you need to be registered for the electronic version of the course at <https://exam.unideb.hu>

NOTE: It only works from IP addresses of the university, so you need to be logged on to EDUROAM, use a PC from the library, or use a VPN connection from outside.

CHAPTER 12

TITLES OF THESES

Department of Anatomy, Histology and Embryology

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

2. Title: Correlation analysis of functional brain maps
3. Title: Investigation of contour integration processing in the primary visual cortex using voltage sensitive dye imaging
Tutor: Zoltán Kisvárdy M.Sc., Ph.D., D.Sc.

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

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

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

10. Title: Matrix metalloproteases in vestibular lesion
Tutor: Botond Gaál M.Sc., Ph.D.

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

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

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

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

15. Title: The endocannabinoid-mediated modulation of spinal nociception

16. Title: The role of astrocytes in spinal pain processing
Tutor: Zoltán Hegyi M.Sc., Ph.D.

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

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

19. 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: The role of the transcription factor BACH1 in macrophage function and tissue homeostasis

2. Title: Transcriptional analysis of the angiogenic effect of macrophages
Tutor: László Nagy M.D., Ph.D., M.H.A.Sc.

3. Title: Characterization of the nuclear tissue transglutaminase

4. Title: The effect of tissue transglutaminase-deficient states on the metabolism of differentiating and terminally differentiated NB4 neutrophil granulocytes

5. Title: The role of tissue transglutaminase in the differentiation of neutrophil granulocytes
Tutor: Zoltán Balajthy M.Sc., Ph.D.

6. Title: Production of dendritic cells and macrophages from embryonic stem cells.

7. Title: Transcriptional programming of dendritic cells

8. Title: Transcriptional programming of embryonic stem cell-derived myeloid cells
Tutor: István Szatmári M.Sc., Ph.D.

9. Title: Bioinformatic analysis of tissue-specific and tumor-specific gene expression regulation
Tutor: László Bálint Bálint M.D., Ph.D.

10. Title: Effects of various coeliac autoantibodies on transglutaminase 2 activities and interactome.

11. Title: Studying structure and function relationship of transglutaminases and its application in translational medicine
Tutor: Róbert Király M.Sc., Ph.D.

12. Title: Epigenetic regulation of homologous recombination

13. Title: Genomic analysis of chromosomal R-loops
Tutor: Lóránt Székvölgyi M.Sc., Ph.D.

14. Title: Analysis of the regulatory elements of the macrophage genome using next generation sequencing data
Tutor: Gergely Nagy M.Sc., Ph.D.

15. Title: Biochemical characterization of retroviral and retroviral-like proteases
Tutor: János Mótyán M.Sc., Ph.D.

16. Title: Analysis of protein interaction networks

17. Title: Metabolomic analysis of saliva

18. Title: Proteomic analyses in diabetes

19. Title: System biology approaches to diabetes
Tutor: Éva Csősz M.Sc., Ph.D.

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

21. Title: Regulation and effector functions of alternatively activated macrophages
Tutor: Zsolt Czimmerer M.Sc., Ph.D.

22. Title: Assembly and analysis of the reference genome for the diploid domestic rabbit using PacBio and 10X Chromium sequencing data

23. Title: Bioinformatic meta-analysis of ChIP-seq and ChIA-PET datasets to understand the regulation of transcriptional units
Tutor: Endre Barta M.Sc., Ph.D.

24. Title: Characterization of adipocytes with thermogenic potential

25. Title: Plasticity of the thermogenic potential of adipocytes, identification of key extrinsic and intrinsic factors

26. Title: The effect of environmental factors on the in vitro differentiation and beigeing potential of primary adipocytes
Tutor: Beáta Bartáné Tóth M.Sc., Ph.D.

27. Title: Investigation of novel molecular elements of the browning machinery in different human adipose tissues

28. Title: Investigation of the biological significance of “batokine” secretion in human cell models
Tutor: Endre Károly Kristóf M.D., Ph.D.

29. Title: Analysis of hemoglobin forms in pathologic states

30. Title: Metabolomic analyses in diabetes
Tutor: Gergő Kalló M.Sc., Ph.D.

31. 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 trastuzumab 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

Tutor: Gábor Szabó M.D., Ph.D., D.Sc.

5. Title: Mathematical analysis and computer modelling of the topology of cell surface proteins

6. Title: Role of MHC in the organization of cell surface proteins

Tutor: László Mátyus M.D., Ph.D., D.Sc.

7. Title: Cytometry of cytotoxic lymphocytes

8. Title: Physiological roles of the multidrug resistance transporter P-glycoprotein

Tutor: Zsolt Bacsó M.D., Ph.D.

9. Title: Elucidation of the catalytic mechanism of ABC transporters

Tutor: Katalin Goda M.Sc., Ph.D.

10. Title: Development of machine learning-based methods for identification of cellular components

11. Title: Effect of the lipid composition of the cell membrane on membrane protein clustering and on cell biological processes related to the cell membrane

12. Title: Role of changes in the dynamic properties of the cell membrane in the protective role of methane against hypoxia-reperfusion injury

Tutor: Péter Nagy M.D., Ph.D., D.Sc.

13. Title: Membrane biophysical and cell biological effects of cyclodextrins

14. Title: The role of the Hv1 proton channel in vascular smooth muscle cells

Tutor: Zoltán Varga M.Sc., Ph.D., D.Sc.

15. 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.

16. Title: Ligand dependence of nuclear receptor

function studied by single molecule microscopy

17. Title: Studying the function and interactions of interleukin-2 and -15 receptors by advanced microscopy

Tutor: György Vámosi M.Sc., Ph.D.

18. Title: Generating and characterizing multicomponent primary human cell cultures for transplantation therapy of stem cell deficient corneas

19. Title: Molecular interactions in histopathological diagnosis: applying FRET in a confocal fluorescence digital pathology slide scanner

20. Title: Optimizing reprogrammed, chimeric antigen receptor (CAR) -transduced human T cells for tumor therapy

21. Title: Role of receptor tyrosine kinases and integrins in the therapy resistance of tumors

Tutor: György Vereb M.D., Ph.D., D.Sc.

22. Title: Ion channel expression of engineered T cells used in cancer immunotherapy

23. Title: Ion channel expression of tumor infiltrating T cell populations

Tutor: Péter Hajdu M.Sc., Ph.D.

24. Title: Genetically engineered NK cells as off-the-shelf living drugs in cancer therapy

25. Title: Universal chimeric antigen receptors (CARs): new weapons for lymphocytes fighting autoimmune diseases

Tutor: Árpád Szöör M.D., Ph.D.

Department of Inorganic and Analytical Chemistry

1. Title: Application of citrate buffers in clinical analysis and diagnosis. (A literature survey)

Tutor: Imre Tóth D.Sc.

2. Title: Experimental methods for the study of redox properties of copper(II) complexes (A literature survey)

Tutor: Katalin Várnagy M.Sc., Ph.D., D.Sc.

3. Title: The role of oxidation of biomolecules by catalysation of metal ions in the development and onset of neurodegenerative disorders. (A literature survey)

Tutor: Csilla Kállay 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., D.Sc.

4. Title: Role of glycoproteins in infection and immunology (bibliographic)

Tutor: János Kerékgyártó M.Sc., Ph.D., C.Sc.

Division of Clinical Physiology

1. Title: Improvement of myocardial inotropy under physiological and pathological conditions

Tutor: Zoltán Papp M.D., Ph.D., D.Sc.

2. Title: The role of angiotensin II in cardiovascular diseases

3. Title: Vascular alterations leading to hypertension.

Tutor: Attila Tóth M.Sc., Ph.D., D.Sc.

4. Title: Angiotensin converting enzymes in the laboratory diagnostics

5. Title: Endogenous regulation of the renin-angiotensin-aldosterone system and its clinical significance

Tutor: Miklós Fagyas M.D., Ph.D.

6. Title: Investigating mechanisms contributing to the myogenic tone of the coronary arteries

Tutor: Viktória Csató M.Sc., Ph.D.

Division of Nuclear Medicine and Translational Imaging

1. Title: Development of interactive E-learning material for nuclear medicine

Tutor: József Varga M.Sc., Ph.D.

2. Title: Importance of FDG PET/CT in cardiology

3. Title: Metabolic parameters in correlation with different oncological therapies

4. Title: Targeted radionuclide therapies in metastatic prostate cancer

5. Title: Targeted radionuclide therapies in neuroendocrin tumors

Tutor: Ildikó Garai M.D., Ph.D.

Division of Radiology and Imaging Science

1. Title: Analysis of Pediatric Radiology Examinations

Tutor: Nóra Vrancsik M.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: Transcriptional regulation of immune responses.

Tutor: Lajos Széles M.Sc., Ph.D.

2. Title: Analysis of mono-ADP-ribosylated proteins from pro- and eukaryotic cells.

Tutor: András Penyige M.Sc., Ph.D.

3. 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.

4. Title: Overview of the background of an arbitrary genetic disorder.

5. Title: Overview of the genetic background influencing the pharmacokinetics and pharmacodynamics of a drug.

Tutor: Judit Keserű M.Sc., Ph.D.

6. Title: MiRNA-profiling of regressive Wilms'

tumors.

7. Title: Studying the role of long non-coding RNAs in glioblastoma.

Tutor: Gergely Buglyó M.D., Ph.D.

8. Title: Investigation the diet–microbiota interactions due to regular sport and personalized nutrition.

9. Title: Next-generation sequencing for the investigation of the small RNA transcriptome in hemato-oncology patients.

Tutor: Melinda Paholcsek M.Sc., Ph.D.

10. Title: Exosomes, as possible biomarkers.

Tutor: Beáta Soltész M.Sc., Ph.D.

11. Title: Study the role of microRNAs in ovarian cancer.

Tutor: Melinda Szilágyi-Bónizs M.Sc., Ph.D.

Department of Immunology

1. Title: The role of the HOF1/SH3PXD2B adaptor protein in the regulation of the tumor microenvironment

Tutor: Árpád Lányi M.Sc., Ph.D.

2. Title: The role of innate immune cells in the development of allergic responses

3. Title: The role of innate lymphoid cells (ILC) in human diseases

Tutor: Attila Bácsi M.Sc., Ph.D., D.Sc.

4. Title: Altered differentiation of monocyte derived dendritic cells and their functional differences

Tutor: Péter Gogolák M.Sc., Ph.D.

5. Title: Investigation of phytocannabinoid effects on human monocyte-derived dendritic cells

6. Title: Investigation of transient receptor potential channels on human monocyte-derived dendritic cells

Tutor: Attila Szöllösi M.D., Ph.D.

7. Title: Identification of new viral sensors and new regulatory mechanisms in the antiviral responses of human dendritic cells

8. Title: Role of dendritic cells in the development of autoimmune diseases

Tutor: Kitti Pázmándi M.Sc., Ph.D.

9. 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: Signal transduction pathways in pulmonary endothelial cells

Tutor: Csilla Csontos M.Sc., Ph.D., D.Sc.

5. Title: Study of metabolic processes with special regard to the involvement of mitochondrial activity.

Tutor: Péter Bay M.Sc., Ph.D., D.Sc.

6. Title: Application of High-Content Screening in Life Sciences

Tutor: Endre Kókai M.Sc., Ph.D.

7. Title: Overcoming insulin resistance by SMTNL1-mimicking peptide

8. Title: Signalling pathways in endometriosis

Tutor: Beáta Lontay M.Sc., Ph.D.

9. Title: Inhibition of sodium-glucose cotransporter of kidney by glucose-based compounds also interfering with glycogenolysis

Tutor: Tibor Docsa M.Sc., Ph.D.

10. Title: Regulation of protein phosphatase-1 by inhibitory proteins and the translocation of the targeting subunit

Tutor: Andrea Kiss M.Sc., Ph.D.

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

12. Title: Autophagy in physiological and pathological processes
Tutor: Katalin Kovács M.Sc., Ph.D.

13. Title: Posttranslational modifications of the mitochondrial fission protein Drp1 and their role on mitochondrial morphology.

14. Title: The effect proteasomal inhibition in Huntington's disease.
Tutor: Krisztina Tar M.Sc., Ph.D.

15. Title: The role of mechanotransduction in the upregulation of CXCL1 in the small intestine
Tutor: Karen Uray 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: Role of HPV in head and neck cancers
Tutor: Krisztina Szarka M.Sc., Ph.D.

3. Title: Evaluation of fungicidal effect of antifungal agents using time-kill curves

4. Title: New and older agents in antifungal chemotherapy
Tutor: László Majoros M.D., Ph.D.

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

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

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

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

9. 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., D.Sc.

4. Title: Lipid abnormalities in hypothyroidism.

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

6. Title: Diagnostic tests and imaging techniques in endocrinology.

Tutor: Endre Nagy M.D., Ph.D., D.Sc.

7. Title: Adipokines and Insulin Resistance

8. Title: Insulin resistance and non-alcoholic fatty liver disease

9. Title: Obesity: Diagnosis and Treatment

10. Title: Obesity: Etiology and Co-morbidities
Tutor: Péter Fülöp M.D., Ph.D. habil.

11. Title: Diabetic neuropathy and oxidative stress

Tutor: Ferenc Sztanek M.D., Ph.D.

12. Title: Autoimmune disorders and GI tract

Tutor: Zsolt Barta M.D., Ph.D.

13. Title: The disease course after stent implantation in peripheral arterial disease

Tutor: György Kerekes M.D., Ph.D.

14. Title: Novel therapeutical approaches in multiple myeloma

15. Title: The impact of multi-drug resistance genes in the prognosis of lymphoproliferative disorders

Tutor: László Váróczy M.D., Ph.D. habil.

16. Title: Inherited and acquired thrombophilia

17. Title: New direct oral anticoagulants

18. Title: Stem cell therapy in peripheral arterial disorders
Tutor: Zoltán Boda M.D., Ph.D., D.Sc.
19. Title: Gastric cancer: clinics and treatment
20. Title: Gastrointestinal bleeding
21. Title: Gluten sensitive enteropathy
22. Title: Inflammatory bowel diseases.
23. Title: Lymphomas in the gastrointestinal tract.
Tutor: István Altorjay M.D., Ph.D., D.Sc.
24. Title: Langerhans histiocytosis
25. Title: Osteosclerotic myeloma
26. Title: Therapeutic challenges in rare haemostatic disorders
Tutor: György Pfliegler M.D., Ph.D. habil.
27. Title: Epidemiology, diagnostics and therapy of chronic hepatitis C
28. Title: Pathomechanism of alcoholic hepatitis
29. Title: Signs, diagnostics and treatment of portal hypertension.
30. Title: Therapeutic options in primary sclerotizing cholangitis
31. Title: Treatment of autoimmune hepatitis
Tutor: István Tornai M.D., Ph.D. habil.
32. 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. habil.
33. Title: Chronic neutrophilic leukaemia
Tutor: Béla Telek M.D., Ph.D.
34. Title: Biological treatment of ulcerative colitis
35. Title: Extraintestinal association in IBD
Tutor: Károly Palatka M.D., Ph.D. habil.
36. Title: The role of Willebrand factor in various internal diseases.
Tutor: Ágota Schlamadinger M.D., Ph.D.
37. Title: Bacterial infection in liver cirrhosis
38. Title: Clinical significance of chronic pancreatitis
39. Title: Current therapeutic options of acute pancreatitis
Tutor: Zsuzsa Vitális M.D., Ph.D.
40. Title: Diagnosis and treatment of chronic lymphocytic leukemia
41. Title: Novel therapeutic approaches in the treatment of multiple myeloma
42. Title: Philadelphia negative chronic myeloproliferative neoplasms - novel genetic and therapeutic improvements
43. Title: Recent advances in the management of chronic ITP
Tutor: Péter Batár M.D., Ph.D.
44. Title: Are the bacterial infections predictable in liver cirrhosis?
45. Title: Role of serological markers in prediction of disease course and response to therapy in inflammatory bowel diseases.
Tutor: Mária Papp M.D., Ph.D. habil.
46. Title: Gastroesophageal 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: Anxiety in the dental chair: pharmacological treatment
4. Title: Arrhythmic patient in dentistry
5. Title: Optional title in pharmacology
6. Title: Parkinson patient in the dental chair
7. Title: Pharmacological and clinical significance of adenosine receptor antagonists
8. Title: Pharmacological and non-pharmacological treatment of endothelial dysfunction
9. Title: Pharmacology of antidepressive drugs: dental implications
10. Title: Pharmacotherapy of trigeminal neuralgia
Tutor: József Szentmiklósi M.D., Ph.D.
11. Title: Emerging roles of prostaglandin DP1

and DP2 receptors in acute and chronic aspects of allergic diseases

12. Title: Optional title in pharmacology

13. Title: Pharmacological treatment of acute decompensated heart failure (ADHF)

14. Title: Pharmacology of herbal remedies

15. Title: Pharmacology of neurogenic inflammation

16. Title: Pharmacotherapy of Amyotrophic Lateral Sclerosis (ALS)

17. Title: Pharmacotherapy of Duchenne Muscular Dystrophy (DMD)

18. Title: Possible pharmacological exploitations of TRPV1 receptors

19. Title: Use of Histone deacetylase inhibitors (HDI): Novel advances in cancer treatment
Tutor: Róbert Pórszász M.D., Dr. habil., MBA, Ph.D.

20. Title: Effect of colony stimulating factors or other drugs on bone marrow-derived cell lines

21. Title: How insulin resistance influences drug effects

22. Title: Selected topic in field experimental hemato-oncology

Tutor: Ilona Benkő M.D., Ph.D.

23. Title: Connections between rheumatoid arthritis and periodontal disease with a focus on pharmacotherapy

24. Title: Immune checkpoint inhibitors in advanced oral cancer

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

26. Title: Class I antiarrhythmic agents: dental implications

27. Title: COX-3 inhibitors in the dental practice

28. Title: Optional title in pharmacology

29. Title: Pharmacotherapy of bronchial asthma: dental implications

30. Title: Reflux disease and the dental patient
Tutor: Ágnes Cseppentő M.D.

31. Title: Optional title on antibacterial chemotherapy

Tutor: Zsuzsanna Gál M.Sc., Ph.D.

32. Title: Optional title in pharmacology

Tutor: Béla Juhász D.Pharm., Dr. habil., Ph.D.

33. Title: Optional title in pharmacology

Tutor: Balázs Varga D.Pharm., Ph.D.

34. Title: Optional title in pharmacology

Tutor: Mariann Bombicz D.Pharm.

35. 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., D.Sc.

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 Szentandrassy 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

1st year**Methods of Molecular Biology:**

J. Sambrook, E. F. Fritsch, T. Maniatis:
Molecular Cloning, A laboratory manual.
3rd edition. Cold Spring Harbor Laboratory
Press, 2001.
Department of Medical Chemistry: Department
of Medical Chemistry.
URL: <http://www.medchem.dote.hu>
R. A. Meyers (ed.): Molecular Biology and
Biotechnology.
A comprehensive desk reference, 1995.

Molecular Immunology:

Peter Parham: The Immune System.
3rd Edition. Garland Science, 2009. ISBN:
ISBN: 0-8153-4146-6.

Biophysics:

Damjanovich, S., Fidy, J., Szöllősi, J.: Medical
Biophysics.
1st edition. Medicina, 2009. ISBN: 978 963 226
249 9.

Molecular Genetics:

Hartl D. L.: Essential Genetics: A Genomics
Perspective.
6th edition. Jones & Bartlett Publishers, 2014.
ISBN: 978-1-4496-8688-8.
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.
4th. Garland Science, 2011. ISBN: 0-8153-4184-
9.
Thomas D. Gelehrter, Francis S. Collins, David
Ginsburg: Principles of Medical Genetics.
2nd. Williams and Wilkins, 1998. ISBN: 0-683-
03445-6.

Medical Genome Biology:

Lesk, Arthur: Introduction to Genomics.
3rd edition. Oxford University Press, 2017.
ISBN: ISBN-13: 978-0198754.
Strachan, T.; Read, AP.: Human Molecular
Genetics.
5th edition. Garland Science, 2019. ISBN: ISBN-
13: 978-0367002.
Csaba Szalai, Valéria László, Sára Tóth, Erna
Pap, András Falus: Medical genetics and
genomics.
URL: <https://elearning.med.unideb.hu>

Radioisotope Techniques In**Biomedicine Practical:**

R. A. Powsner, M. R. Palmer, E. R. Powsner:
Essentials of Nuclear Medicine Physics and
Instrumentation.
3rd. Wiley-Blackwell, 2013. ISBN: 978-0-470-
90550-0.

Radioisotope Techniques in**Biomedicine:**

R. A. Powsner, M. R. Palmer, E. R. Powsner:
Essentials of Nuclear Medicine Physics and
Instrumentation.
3rd. Wiley-Blackwell, 2013. ISBN: 978-0-470-
90550-0.

Biochemistry of Metabolism:

Thomas M. Devlin: Textbook of Biochemistry
with Clinical Correlations.
6th edition. Wiley-Liss, 2006.

Human Physiology I.:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002.
ISBN: 963-242-726-2.
Physiology Practice. A Laboratory Guide.
revised edition.2000.
Physiology Practice. Exercise Book.
revised edition.2000.

Biochemistry Practical I.:

Ed. Dombrádi, V.: Laboratory Practicals in

Medical Chemistry.
Medical and Health Science Center, University
of Debrecen, 2009.

Hungarian Language I.:

Gerő Ildikó-Kovács Judit: Színesen magyarul.
2017.

Physiology of Prokaryotes and Molecular Virology:

Dimmock, N., Easton, A., Leppard, K.:
Introduction to Modern Virology.
6th edition. Wiley-Blackwell, 2007.
White D.: The Physiology and Biochemistry of
Prokaryotes.
3rd edition. Oxford University Press, 2006.
Alan J. Cann: Principles of Molecular Virology.
5th edition. Elsevier Ltd., 2012.
Carter, J., Saunders, V: Virology: Principles and
Applications.
Wiley, 2007.

Cell Biology:

Alberts et al.: Essential Cell Biology.
3rd edition. Garland Public Inc., 2004. ISBN: 0-
8153-3481-8.
Lodish et al.: Molecular Cell Biology.
4th edition..
Alberts et al.: Molecular Biology of the Cell.
5th edition. Garland Public Inc., 2007.

Biostatistics:

Wayne W. Daniel: Biostatistics. A foundation for
Analysis in the Health Sciences.
John Wiley & Sons, ISBN: 0-471-16386-4.

Plant Molecular Biology:

Taiz, L., Zeiger, E.: Plant Physiology.
Sinauer Associates, Inc., Publishers, Sunderland,
Massachusetts, 2003.
: Selected thematic reviews from Progress in
Botany.
: Annual Review of Plant Biology.
: Tansley reviews of New Phytologist.

Human Physiology II.:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002.

ISBN: 963-242-726-2.

Physiology Practice. A Laboratory Guide.
revised edition.2000.

Physiology Practice. Exercise Book.
revised edition.2000.

Human Physiology Practicals:

A. Fonyó: Principles of Medical Physiology.
Medicina Publishing House, Hungary, 2002.
ISBN: 963-242-726-2.

Physiology Practice. Exercise Book.
revised edition.2000.

Physiology Practice. A Laboratory Guide.
revised edition.2000.

Methods in Molecular Biology Practicals:

J. Sambrook, E. F. Fritsch, T. Maniatis:
Molecular Cloning, A laboratory manual.
3rd edition. Cold Spring Harbor Laboratory
Press, 2001.

Department of Medical Chemistry: Department
of Medical Chemistry.

URL: <http://www.medchem.dote.hu>

R. A. Meyers (ed.): Molecular Biology and
Biotechnology.

A comprehensive desk reference, 1995.

Hungarian Language II.:

Mezei Zsuzsa Livia- Fodor Marianna: Szívből
magyarul.

Cell Biology Practice:

Cell Biology Laboratory Manual.
Department of Biophysics and Cell Biology,
2003.

Lodish et al.: Molecular Cell Biology.
4th edition..

Alberts et al.: Molecular Biology of the Cell.
5th edition. Garland Public Inc., 2007.

Cell Biology Practice:

Cell Biology Laboratory Manual.
Department of Biophysics and Cell Biology,
2003.

Lodish et al.: Molecular Cell Biology.
4th edition..

Alberts et al.: Molecular Biology of the Cell.

5th edition. Garland Public Inc., 2007.

2nd year

Bioinorganic Chemistry:

Gergely, P.: Introduction to Bioinorganic Chemistry for Medical Students. Medical and Health Science Center, University of Debrecen, 2008.

Impaired Signal Transduction in the Immune System:

Abbas, A. K., Lichtman, A. H., Pillai, S.: Basic Immunology. 4th Edition. Saunders, 2012. ISBN: 1-4557-0707-4.

Signalling Pathways in the Cells:

Alberts et al.: Essential Cell Biology. 3rd edition. Garland Public Inc., 2004. ISBN: 0-8153-3481-8.
: Cell Signalling Biology.
URL: <http://www.biochemj.org/csb/>

Signalling Pathways in the Cells:

Alberts et al.: Essential Cell Biology. 3rd edition. Garland Public Inc., 2004. ISBN: 0-8153-3481-8.
: Cell Signalling Biology.
URL: <http://www.biochemj.org/csb/>

Impaired Signal Transduction in the Immune System:

Abbas, A. K., Lichtman, A. H., Pillai, S.: Basic Immunology. 4th Edition. Saunders, 2012. ISBN: 1-4557-0707-4.

Human Pathogenic Bacteria:

Warren Levinson: Medical Microbiology and Immunology. 11th edition. The McGraw-Hill Comp, 2010. P. R. Murray, K. S. Rosenthal, M. A. Pfaller: Medical Microbiology. 7th edition. Elsevier Inc., 2013.

Human Pathogenic Bacteria Practicals:

Warren Levinson: Medical Microbiology and Immunology.

11th edition. The McGraw-Hill Comp, 2010. P. R. Murray, K. S. Rosenthal, M. A. Pfaller: Medical Microbiology. 7th edition. Elsevier Inc., 2013.

Bioinorganic Chemistry:

Gergely, P.: Introduction to Bioinorganic Chemistry for Medical Students. Medical and Health Science Center, University of Debrecen, 2008.

Basis of Conventional and Biological Immunotherapies:

Abbas, A. K., Lichtman, A. H., Pillai, S.: Basic Immunology. 4th Edition. Saunders, 2012. ISBN: 1-4557-0707-4.
Peter Parham: The Immune System. 3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.
Fred S. Rosen: Case Studies in immunology. 3rd edition. 2001.

Immunological Methods in Molecular Biology:

Abul K. Abbas: Cellular and Molecular Immunology. 8th Edition. Elsevier, 2014. ISBN: 9780323222754.
Kenneth Murphy: Janeway's Immunobiology. 8th Edition. Garland Science, 2011. ISBN: 9780815342434

New System Biology Paradigms in Immunology:

Peter Parham: The Immune System. 3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.

Human Pathogenic Viruses:

Warren Levinson: Medical Microbiology and Immunology. 11th edition. The McGraw-Hill Comp, 2010. P. R. Murray, K. S. Rosenthal, M. A. Pfaller: Medical Microbiology. 7th edition. Elsevier Inc., 2013.

Basis of Conventional and Biological

Immunotherapies:

Abbas, A. K., Lichtman, A. H., Pillai, S.: Basic Immunology.

4th Edition. Saunders, 2012. ISBN: 1-4557-0707-4.

Peter Parham: The Immune System.

3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.

Fred S. Rosen: Case Studies in immunology. 3rd edition. 2001.

Immunological Methods in Molecular Biology:

Abul K. Abbas: Cellular and Molecular Immunology.

8th Edition. Elsevier, 2014. ISBN: 9780323222754.

Kenneth Murphy: Janeway's Immunobiology.

8th Edition. Garland Science, 2011. ISBN: 9780815342434

New System Biology Paradigms in Immunology:

Peter Parham: The Immune System.

3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.

Selected topics of Immunology:

Peter Parham: The Immune System.

3rd Edition. Garland Science, 2009. ISBN: ISBN: 0-8153-4146-6.