SYLLABUS

MEDICAL MOLECULAR BIOLOGY

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	"Babeş-Bolyai" University Cluj-Napoca
1.2. Faculty	Faculty of Biology and Geology
1.3. Department	Biology and Ecology Department of Hungarian Line
1.4. Field of study	Biology
1.5. Study cycle	4 semesters
1.6. Study programme/Qualification	Medical Biology/Master of Medical Biology
1.7. Form of education	With frequency

2. Information regarding the discipline

2.1. Name of the discipline	Medical Molecular Biology (in English)					Discipline code	BME6203
2.2. Course coordinator				Dr. Kovacs Levente, assistant professor			
2.3. Seminar coordinator				Dr. Kovacs Levente, assistant professor			
2.4. Year of study	I	2.5. Semester	2	2.6. Type of evaluation	E	2.7. Discipline regime	Ob.

3. Total estimated time (hours/semester of didactic activities)

3.1. Hours per week	**4**	of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4. Total hours in the curriculum	154	of which: 3.5 course	28	3.6 seminar/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					40
Additional documentation (in libraries, on electronic platforms, field documentation)					30
Preparation for seminars/labs, homework, papers, portfolios and essays					24
Tutorship					2
Evaluations					2
Other activities:					0
3.7. Total individual study hours	**98**				
3.8. Total hours per semester	**154**				
3.9. Number of ECTS credits	**6**				

4. Prerequisites (if necessary)

4.1. curriculum	Genetics, Applied molecular biology
4.2. competencies	Knowledge on key concepts of molecular biology and genetics

5. Conditions (if necessary)

5.1. for the course	Course room with laptop, with video projector and with necessary software (Power Point, Word), multimedia appliances, Internet.
5.2. for the seminar /lab activities	Megfelelően felszerelt laboratórium: általános laboratóriumi eszközök, centrifugák, fénymikroszkópok. Ezeket az eszközöket a Biológia-Földtan Kar bocsátja a rendelkezésre.

6.1. Specific competencies acquired [1]

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

Professional/essential competencies	• Cognition, understanding and acquirement of the advanced concepts, theories and methods of biology as well as the adequate use of them in the professional communication.
Transversal competencies	• Ability of working in groups of life sciences researchers, ability of resolving problems and making decisions, organization of activities in a group.

6.2. Learning outcomes

Knowledge	The student knows the concepts and techniques of medical molecular biology and their applications
Skills	The student is able to understand, discuss and plan experiments on the field of medical molecular biology
Responsibility and autonomy:	The student has the ability to work independently to obtain results with diagnostic values on the field of medical molecular biology

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• The course follows the concepts, principles and methods of molecular biology while familiarizing the students with the use of these in clinical laboratories
7.2 Specific objective of the discipline	• Development of the capacity to understand the principles of the methods used in molecular biology laboratories and the currently used technologies of molecular diagnostics. • Formation of the ability of using the molecular biology technologies applied in clinic and diagnostic laboratories

8. Content

8.1 Course	Teaching methods	Remarks
Introduction into the Molecular Biology. Definition. Basic Concepts. The Brief History of the Molecular Biology. The Structure and Functions of the Nucleic Acids. (1: 1-48, 2: 51-73, 4: 1-12, 23-37)	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Isolation and Purification of Nucleic Acids. Isolation of DNA and RNA. Organic and Inorganic Isolation Methods. Solid Phase Extraction. Determination of the Purity and Concentration of the Nucleic Acids. Electrophoresis. Spectrophotometry. Fluorometry. (2: 567-570, 4: 69-86)	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Separation of Nucleic Acids with Electrophoresis. Pulsed Field Gel Electrophoresis (PFGE). Polyacrylamide Gel Electrophoresis. Capillary Gel Electrophoresis. Buffer Systems. Nucleic Acid Dyes. (2: 570-574, 582-588, 4: 87-101).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Nucleic Acid Modifying Enzymes. Nucleases. Secondary Modifying Enzymes. Ligases. Restriction Endonucleases. Polymerases. Tertiary Modifying Enzymes. (1: 50-74, 2: 600-610).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Molecular Cloning of the DNA. Creating of Recombinant DNA. Cloning, Transcription and Expression Vectors. Amplification of the Recombinant DNA. (1: 50-74, 2: 610-631)	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Nucleic Acid and Proteine Hybridization Technologies. Southern Blot. Northern Blot. Western Blot. Eastern Blot. Nucleic Acid Probes. Protein Probes. Classical and Modern Detection Methods. Interpretation of the Results. (1: 50-74, 2: 590-595, 4:102-122).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Modern Hybridization Methods. Dot/Slot – Blot. Macroarray and Microarray Technologies. DNA Chip. Karyotyping. Fluorescence in situ Hybridization (FISH). Interphase and Metaphase FISH. (2: 595-598, 709-716, 4:122-127,175-183)	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
DNA Amplification Technologies. Polymerase Chain Reaction (PCR). Simple PCR Technology. Components of a Typical PCR Reaction. PCR Programs. Primers. Thermocyclers. PCR Modifications: multiplex-PCR, reverse transcriptase PCR, nested PCR, real time PCR. (2: 634-661, 4: 130-151).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Classical and Modern DNA Sequencing Methods. Direct Sequencing: Maxam-Gilbert and Sanger Methods. Pyrosequencing. Bisulfite Sequencing. Emulsion and Bridge PCR. Next Generation Sequencing. NGS Systems. (1:50-74, 2: 662-680, 686-690, 4:222-238).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Genomics and Proteomics. Basic Concepts. Genome Projects. Human Genome Project. Clinic Genome and Exome Sequencing. Human Proteome Project. Omics. (1: 759-826, 2: 680-686, 690-693, 4:240-244).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Isolation and Purification of Proteins. Identification and Sequencing of Proteins. (2: 717-744).	•Interactive exposure •Explanation •Conversation	2 hours

	•Didactical demonstration	
Molecular Diagnostics in Human Identification, Genetics and Oncology. Single- nucleotide Mutations (SNP). Polynucleotide Polymorphisms. RFLP Technology. STR Typing by PCR. FBI CODIS Database. Epigenetic Alterations. Single-gene Diseases: Leiden Mutation, Hemochromatosis, Cystic Fibrosis. Molecular Oncology. EGFR, K-ras, BRCA1 and BRCA2 (1: 759-826, 493-498, 4:249-255, 342-355).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Molecular Diagnostics in Bacteriology and Virusology. The Importance of Molecular Diagnostics of the Microorganisms. Sampling and Preparation of Samples. Control Processes and Quality Assurance. Melting Point. Infection Diagnostics in the Respiratory and Urinary tracts. (1: 759-826, 4:289-305)	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours
Gene Therapy. Gene Attenuation and Knock-out Technologies. (1: 759-826).	•Interactive exposure •Explanation •Conversation •Didactical demonstration	2 hours

Bibliography
Obligatory bibliography:

1.Weaver, R. F.: Molecular biology, McGraw-Hill, New York, 2012 – Zoological Library, code: 18399
2. Clark, D. P.: Molecular biology, Elsevier Academic Press, New York, 2005 – Animal Physiology Library, code: 1391, Zoological Library, code: 17878
3. Sambrook, J.: Molecular cloning: a laboratory manual, Cold Spring Harbor Laboratory Press, Plainview, 1989 – Zoological Library, code: 16255
4. Buckingham, L.: Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, F.A. Davis Company, Philadelphia, 2012 – Animal Physiology Library, code:1542

Optional bibliography:

1. McPherson, R. A., Pincus, M. R.: Henry's clinical diagnosis and management by laboratory methods, Elsevier Saunders, Philadelphia, 2011 – Animal Physiology Library, code: 1580
2. Weaver, R. F., Hedrick, Ph. W.: Genetika, Panem, Budapest, 2000 – Zoological Library, code: 17084.

8.2 Seminar / laboratory	Teaching methods	Remarks
Molecular Biology Laboratory Organization. Work Protection Rules and Risk Management. 1: A1.1; 2: 1).	Interactive exposure. Conversation.	2 hours
Isolation and Purification of DNA from Clinic Probes. Determination of DNA Concentration and Purity (1: 5.1, 6.1; 2: 2, 3).	Interactive exposure. Explanation Conversation. Experimental Demonstration.	8 hours
DNA Amplification Methods. PCR. Separation of DNA Fragments Using Gel electrophoresis (1: 5.1; 2: 4,5).	Interactive exposure. Explanation Conversation. Experimental Demonstration.	8 hours
Oligonucleotide Primer Design (2: 6).	Interactive exposure. Explanation Conversation. Experimental Demonstration.	2 hours
Analysis of DNA Sequences. Visualization, Assembling and Identification of DNA fragments. (1: A11.1; 2: 7).	Interactive exposure. Explanation Conversation. Experimental Demonstration.	2 hours
Molecular diagnostics Seminary I.	Interactive exposure. Explanation Conversation.	2 hours
Molecular diagnostics Seminary II.	Interactive exposure. Explanation	2 hours

	Conversation.	
Make up session/Review session.	Interactive exposure. Explanation Conversation.	2 hours
Bibliography 1. Sambrook, J.: Molecular cloning: a laboratory manual, Cold Spring Harbor Laboratory Press, Plainview, 1989 – Zoological Library, code: 16255 2. Jakab, E.: Medical Molecular Biology – Laboratory Practices, 2019		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The content of the discipline is in accordance with the contents thought in other Romanian universities and in foreign countries.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Verification of the theoretical knowledge	Written exam at the end of the semester	80%
10.5 Seminar/laboratory	Verification of the practical knowledge	Written exam at the end of the semester	10%
	Evaluation of the presentations	Evaluation of the presentations during the seminary sessions.	10%
10.6 Minimum standard of performance			

- Cognition of the basic concepts and principles, the minimal note is 5.

11. Labels ODD (Sustainable Development Goals)[2]

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable*.".

	General label for Sustainable Development							
								
								

Date:
08.01.2025

Signature of course coordinator

Dr. Kovacs Levente

Signature of seminar coordinator

Dr. Kovacs Levente

Date of approval:
08.01.2025

Signature of the head of department

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