COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Molecular Genetics Laboratory	

Academic staff	Core academic unit(s)
Coordinating: dr. Kristina Daniūnaitė, assoc. prof. **Other: -**	Life Sciences Center

Study cycle	Type of the course unit
First-cycle / Second-cycle (suitable for advanced undergraduates and early graduate students)	Optional

Mode of delivery	Semester or period when it is delivered	Language of instruction
In-person laboratory and classroom session: practical laboratory work (wet lab), lectures/seminars, tasks in virtual learning environment (VLE)	Spring semester	English

Requisites	
Prerequisites: Basic knowledge of molecular biology, genetics, and cell biology; introductory course in biochemistry is recommended. Students are expected to be familiar with fundamental concepts in DNA structure, gene expression, and basic laboratory safety.	**Co-requisites (if relevant):** none

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
5 ECTS	104 hours	44 hours	60 hours

Purpose of the course unit		
The purpose of this course is to provide students with practical experience in fundamental molecular genetics techniques, with an emphasis on DNA and RNA analysis. The course aims to develop students' familiarity with common laboratory methods, experimental planning, and basic data interpretation, preparing them for further study or research in molecular genetics and molecular biology.		
Learning outcomes of the course unit	**Teaching and learning methods**	**Assessment methods**
Perform basic molecular genetics techniques, including DNA/RNA extraction, qualitative and quantitative PCR, and restriction enzyme analysis.	Hands-on laboratory sessions, guided demonstrations, supervised practical exercises.	Observation of lab performance, practical lab reports, completion of assigned experiments, written test on methodologies
Assess and interpret nucleic acid quality, quantity, and experimental results using standard laboratory methods	Lab exercises with spectrophotometry, gel electrophoresis, PCR/qPCR data, instructor-led discussions	Lab report data analysis sections, written test on data interpretation
Apply proper laboratory practices and safety procedures when handling nucleic acids and conducting experiments	Demonstration of safety procedures, discussion of biosafety principles, monitoring during lab work.	Observation of adherence to safety protocols, lab performance evaluation, practical skills checklist

Communicate experimental procedures and findings effectively through written reports and/or presentations	Lab report writing, group discussions, guidance on scientific communication	Written lab reports, oral presentation, peer and instructor feedback

Content	Contact hours							Individual work: time and assignments	
	Lectures	Tutorials	Seminars	Workshops	Laboratory work	Internship	Contact hours, total	Individual work	Tasks for individual work
1. DNA extraction and quality control (isolation of genomic DNA from animal cells, assessment of purity and concentration, gel electrophoresis)	1				4		5	4	Study DNA extraction protocols and other theory; complete pre-lab quiz on DNA isolation principles and laboratory safety; analyze experimental data obtained in the lab; fill in lab notebook
2. Conventional end-point PCR (human Rh blood group determination or alternative application)	1				4		5	6	Review PCR theory and primer design principles; complete pre-lab quiz on PCR setup and expected results; process raw data files obtained in the lab and determine Rh phenotype; fill in lab notebook
3. Restriction fragment length polymorphism (RFLP) analysis (human ABO blood group genotyping or, alternatively, mtDNA haplotype determination)	1				8		9	10	Study RFLP theory and examples; complete pre-lab exercises; process raw data files obtained in the lab and determine genotype; fill in lab notebook
4. Real-time PCR for genotyping (SNP/CNV analysis at selected locus)	1				4		5	8	Study qPCR principles and SNP/CNV analysis; complete pre-lab quiz on qPCR setup and data interpretation; analyze experimental data obtained in the lab; fill in lab notebook
5. RNA extraction and quality control (isolation of total RNA from mammalian cells, assessment of integrity and concentration)	1				4		5	4	Study RNA extraction and QC protocols; complete pre-lab quiz on RNA handling; analyze RNA conc. and integrity data obtained in the lab; fill in lab notebook

6. Reverse transcription and real-time PCR for gene expression quantification (intercalating dye and probe-based detection principles)	1				8		9	8	Study RT-qPCR theory, primer design, and dye/probe detection principles; complete pre-lab quiz on experimental design and expected outcomes; analyze data from qPCR experiments; fill in lab notebook
7. Data analysis and integration across experiments, scientific presentation, feedback exchange			4				4	10	Compile all experimental data from wet lab sessions; perform preliminary analysis of the results; submit lab reports via VLE; prepare presentation slides
8. Written test			2				2	10	Complete VLE-based revision exercises; study lecture notes, lab manuals, and previous report data.
Total	**6**	**-**	**6**	**-**	**32**	**-**	**44**	**60**	

Assessment strategy	Weight %	Deadline	Assessment criteria
Laboratory works (compulsory)	10%	During the semester	Attendance in lab works is compulsory. Detailed assessment criteria are provided to students during the introductory lecture at the start of the course.
Written test (compulsory)	60%	During the semester	Cumulative score. The test consists of at least 30 questions, primarily multiple-choice, but also including true/false, short-answer, and other question types. The test is past if a student receives at least half of the maximum points. If the test is failed, taking the exam is compulsory.
Completion of exercises (compulsory)	10%	During the semester	Cumulative score.
Presentation of experimental data (compulsory)	20%	During the semester	Cumulative score. Detailed requirements and assessment criteria are provided to students during the introductory lecture at the start of the course.
Additional exercises (optional)	Extra points	During the semester	Cumulative score.
Written examination	100%	During the exam session	If a student achieves ≥50.0% of the cumulative score, completes all laboratory work, and fulfills all other compulsory activities: • The cumulative score is proportionally converted into a 10-point system as a preliminary mark; • the student may opt not to take the exam; in this case, the preliminary mark is considered the final grade; • if the student chooses to take the exam, the exam result will be considered the final grade.

			If a student achieves <50.0% of the cumulative score or fails the test, but completes all laboratory work and other compulsory activities, the student must take the exam. The exam score will then be considered the final grade. If a student fails the laboratory work or does not complete at least one compulsory activity, he/she does not receive a preliminary mark and is ineligible to take the exam. The examination consists of 3-6 open-ended questions covering all topics discussed throughout the course.

Author (-s)	Publishing year	Title	Issue of a periodical or volume of a publication	Publishing house or web link
Required reading				
[Moderated by the coordinating lecturer]	-	Materials for laboratory exercises and individual assignments	-	VLE (Moodle) – course's webpage
Reagent manufacturers' websites	-	Protocols, product datasheets, and technical information relevant to the experiments	-	https://www.thermofisher.com/lt/en/home.html https://www.qiagen.com/us and others
Selected thematic research papers and reviews	2020 or newer	Research papers and reviews, book chapters, covering the theory and applications of the techniques used in the course	-	various
Recommended reading				
Online video tutorials	-	Free instructional videos demonstrating the laboratory techniques	-	YouTube channels such as JoVE Science Education, Learn Genetics, or institutional lab tutorials