Course code	Course group	Volume in ECTS credits	Course hours
BIO5005	C	6	160

Course type (compulsory or optional)	**Compulsory**
Course level (study cycle)	**MA Courses**
Semester the course is delivered	**Spring**
Study form (face-to-face or distant)	**Face-to-face**

Course title in Lithuanian

MOLEKULINĖ BIOTECHNOLOGIJA

Course title in English

MOLECULAR BIOTECHNOLOGY

Short course annotation in Lithuanian

Baltymų inžinerija. Baltymų konstravimo *in vitro* principai. Baltymų kūrimas *de novo* ir *in silico*. Baltymų producentų kūrimas. Abzimų – katalitinėmis savybėmis pasižyminčių antikūnių modeliavimas, inžinerija ir gamyba. Ribozimai ir aptamerai. Fermentų specifiškumo, termostabilumo ir kitų savybių keitimas norima linkme. Kombinatoriniai polipeptidų sintezės metodai. Fermentų panaudojimas organinėje chemijoje. Baltoji biotechnologija. Stereoselektyvios sintezės. Metabolizmo kelių konstravimas. Genų terapija. Nanobiotechnologijos.

Short course annotation in English

Protein engineering – basic principles and methods. Construction of protein producers. Abzymes.Ribozymes and aptamers. Directed evolution of enzymes. Combinatorial syntheses. Biocatalysis in organic chemistry. White biotechnology. Stereoselective synthesis. Metabolic engineering. Gene therapy.

Prerequisites for entering the course

Molecular Biology, Molecular Laboratory Diagnostics, Molecular Ecology.

Course aim

The aim of the course is to provide structured knowledge about molecular biotechnology problems, their main principles, methods and technology.

Links between course outcomes and criteria of learning achievement evaluation

Course outcomes	Criteria of learning achievement evaluation	Content (topics)
Know the main objects of biotechnology, development principles, the scope of biotechnology. Know terminology of biotechnology and be able to analyse biotechnological	Be able to analyze and explain the biotechnological processes.	General biotechnological processes: Objects used in biotechnology (cell components (DNA, RNA, proteins, polysaccharides, lipids and other low molecular weight materials), micro-organisms, plant and animal cells, multicellular organisms (plants and animals)). White (industrial), red, green, and blue biotechnology and the main application areas of biotechnology (food industry, chemical industry, agriculture, medicine, energy, ecological purity). Steps of biotechnological process (obtaining biomass, biomass disassembly, component

processes.		purification, analysis, control). Classic biotechnological processes. Fermenter and their types. Eukaryotic (animal) cell culture characteristics.
Know the basic application of industrial biotechnology facilities, enzymes and biocatalysis principles. Be able to explain the principles of Biocatalysts design.	Be able to deal issues of industrial biotechnology, genetic engineering, know the basic principles, methods, techniques, think analytically.	Industrial biotechnology: Objects of Industrial Biotechnology (biocatalysts, their immobilization, biocata processes, their construction and control). Renewable sources of raw materials. Enzyme selection, immobilization and use. GeneticEngineering(hosts,vectors,gene expression). Protein engineering. Metabolic processes in construction. Production of antibiotic. Recombinant antibiotics. Synthetic biology.
Know the basic red biotechnology objects and scope. Be able to explain the principles of drug development.	Be able to understand the creation of biological objects and the use of the practical problems, especially in relation to medicine, to address.	Red biotechnology: Objects of red biotechnology (therapeutic proteins, recombinant proteins for medicines, antibodies, ribozymes, hybrid proteins). Principles of Drug Development (drug target search methods, methods of active materials selection, bacteriophages, ribosomes and cell exposure system, RNA silencing, aptamers, toxicity and pharmacokinetics).
Know the basic an ohmic technology. To be able to explain the principles of ohmic technology.	Be able to deal issues of ohmic technology, sequencing methods. Know the basic principles, methods, techniques, think analytically.	Ohmic technology: Methods of genome analysis. High-speed sequencing methods (pirosequencing, iSolid, Illumina and others). The problems of DNA sequence analysis. Methods of RNA analysis. Transcriptomics. DNA arrays. DNA (RNA) sensors. Proteomics - methods and problems. Mass spectrometry (principles of method, the excitation technology and applications). Metabolomics. Interactomics. Trends of ohmic technology. Biomarkers. Resistive technology and drug synthesis. Perspective of individualized treatment.
Know the main target of plant and animal design goals and methods. To be able to explain the principles of construction of transgenic organisms and their scope.	Be able to actively use knowledge of biology, chemistry, cell biology, genetics and biochemistry in the examination of biotechnological processes in the development and application problems.	Construction of cells and organisms: The target plant and animal cell construction - methods and problems. Transgenic plants (construction, areas of use, problems). Transgenic animals (design, applications, problems). Human Gene Therapy (vectors, the target gene routing, manipulation ex vivo).
Know the general nanobiotechnologies and visualization technology targets. To	Be able to deal issues of nanobiotechnology, know the basic principles, methods, techniques,	Nanobiotechnology and visualization technology: Biotechnology in nanometric level. Self-

be able to explain the development and application of nanobiotechnology features.	think analytically.	assembled structures. Nanoprimers and their use in in vivo visualization methods. Protein arrays. Multiparameter analysis. Laboratory chips.
Know the basic techniques for the development of vaccines. To be able to explain the main classical and modern vaccine creation principles.	Be able to explain the principles of biotechnology creation.	Vaccines: Traditional and new vaccines. Vaccines against cancer. Recombinant protein in vaccines development. DNA vaccines. Intracellular vaccine.
Know the scope of stem cell. To be able to explain the principles of cellular therapies.	Be able to deal issues of Molecular Biotechnology, know the basic principles, methods, techniques, think analytically. Be able free to use the terminology of Molecular Biotechnology, comprehend of the basic patterns.	Cellular technology: Autologous and embryonic stem cells (extraction methods, the main characteristics). Induced pluripotent cells. Tissue and organ reconstruction of stem cells. Tissue and organ engineering.

Content (topics)

1. General biotechnological processes
2. Industrial biotechnology
3. Red biotechnology
4. Ohmic technology
5. Construction of cells and organisms
6. Nanobiotechnology and visualization technology
7. Vaccines
8. Cellular technology

Methods of study (teaching and learning)

Lectures, practical training and seminars. During seminars there will be literature study with guided student presentations, and group work; discussion of research papers and reviews, problems on Basic Biotechnology are solved. Participants are encouraged to share their work experiences with the class when they are relevant to the theories. Technical skills using methods in Basic Biotechnology are gained in practicals.

Distribution of workload for students (contact and independent work hours)

Lectures – 45 hours, laboratory work– 15 hours, examination – 3 hours, individual work – 97 hours.

Structure of cumulative score and value of its constituent parts

Final assessment sums the assessments of written mid-term examination (17%), assessment of laboratory works (33%) and written final examination (50%),

Recommended reference materials

Nr.	Publication year	Authors of publication and title	Publishing house	Number of copies in		
				University library	Self-study rooms	Other libraries
Basic materials						

1.	2006	Basic Biotechnology. Eds. C. Ratledge, B. Kristiansen	Cambridge University Press.		1	
2.	2007	Gary Walsh. Pharmaceutical Biotechnology. Concepts and Applications.	John Wiley & Sons Ltd..		1	
3.	2009	E. Smith. Biotechnology (fifth edition).	Cambridge University Press.		1	
Other materials						
1.	2011	Philip R. Dormitzer, Christian W. Mandl, Rino Rappuoli (Editors). Replicating Vaccines. A New Generation.	Springer Basel AG.			

Course programme designed by

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