Faculty of Medicine in Rijeka

Curriculum
2025/2026

For course

Basics of Genetic Engineering

Study program:	**Medical Studies in English (R)** (elective) University integrated undergraduate and graduate study
Department:	**Centre for Proteomics**
Course coordinator:	**dr. sc. Lisnić Berislav, dipl. ing.**
Year of study:	**1**
ECTS:	**1.5**
Incentive ECTS:	**0 (0.00%)**
Foreign language:	**Possibility of teaching in a foreign language**

Course information:

Major goal of this course is to familiarize students with a) basic concepts and definitions in genetic engineering, b) modern genetic engineering techniques and c) their applications in medicine. The second goal is to transfer to the students knowledge and skills required for work in research laboratories in which recombinant DNA technology is routinely used. The third goal of this course is to enable students to independently form an informed opinion about recombinant DNA technology. Upon completion of this course the students will be able to understand basic principles and methodology of genetic engineering, and will be able to plan and perform a construction of a recombinant plasmid DNA.

List of assigned reading:

1) Zabilješke s predavanja i vježbi

2) Odabrana poglavlja iz **a) *Molecular Biology of the Cell – 6th edition (2015)***

Autori**:** Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter

b) *Gene cloning & DNA analysis – 7th edition (2016)*
Autor**:** T. A: Brown

c) *Molecular Cloning: A laboratory manual – 4th edition (2012)*
Autori: Michael R. Green and Joseph Sambrook

List of optional reading:

1) Molecular Clonong – Technical Guide, New England Biolabs, slobodno dostupno na

https://www.neb.com/~/media/NebUs/Files/Brochures/Cloning_Tech_Guide.pdf

Curriculum:

Lectures list (with titles and explanation):

Lecture 1 - Introduction to genetic engineering

After the first lecture, students will be able to:

Understand the definition of genetic engineering and provide examples of the use of genetic engineering in real life
Understand and describe the basics of nucleic acids structure, replication, transcription, and translation
Solve basic problems related to DNA/RNA structure and processes of replication, transcription, and translation

Lecture 2 - Enzymes in genetic engineering

After the 2nd lecture, students should be able to:
Explain the terms endonuclease, exonuclease, ligase, polymerase, kinase, phosphatase, recombinase, restriction endonuclease, reverse transcriptase, sticky ends, blunt ends, palindromic sequences.
Describe the activities of DNA manipulative enzymes in general terms.
Describe and explain the principle of gel electrophoresis of DNA molecules.
Solve basic problems related to activities that DNA manipulative enzymes exhibit on various nucleic acid substrates.

Lecture 3 - Vectors for gene cloning

After the 3rd lecture, students will be able to:
Understand and explain the most basic types and properties of the most common vectors used for gene cloning in *E. coli.*
Understand and explain the differences and similarities between genomic and cDNA libraries.

Lecture 4 - Polymerase chain reaction (PCR)

After the 4th lecture, students will be able to:
Understand and explain the basic principles of a PCR reaction, primer design, and selection of appropriate thermocycling conditions.
Understand and explain the issue of fidelity of PCR amplification with Taq DNA polymerase.
Describe and explain the principle of gel electrophoresis of PCR products.
Solve basic problems related to PCR and DNA electrophoresis of DNA molecules.

Lecture 5 - Hybridization-based nucleic acid assays

After the 5th lecture, students will be able to:
Understand and explain the process of DNA denaturation/renaturation, and basic principles of nucleic acid hybridization analyses and their applications.
Solve basic problems related to hybridization-based nucleic acid assays.

Lecture 6 - Sequencing of genes and genomes

After the 6th lecture, students will be able to:
Understand and describe Sanger dideoxy sequencing and Illumina SBS sequencing methods.
Deduce the order of nucleotides in an unknown DNA sequence based on the results of the Sanger sequencing.

Lecture 7 - Applications of genetic engineering

After the 7th lecture, students will be able to:
Name and briefly describe examples of uses of genetic engineering in medicine.
Perform basic interpretation of DNA profiles obtained by DNA fingerprinting.
Understand the basic principles of CRISPR/Cas9 technology.

Practicals list (with titles and explanation):

Laboratory exercise 1 - Introductory class

By the end of the 1st laboratory exercise, students should:
Acquire basic proficiency in accurate and reproducible pipetting using air-displacement micropipettes
Be able to understand and describe the overall goal of the laboratory exercices

Laboratory exercise 2 - Vector and insert preparation

By the end of the 2nd laboratory class, students will be able to independently:
Isolate a plasmid DNA from *E. coli* cells.
Set-up a PCR, and a restriction enzyme digestion reaction.
Prepare DNA samples for agarose gel electrophoresis.
Load DNA samples into wells of an agarose gel.
Run an agarose gel.
Understand the requirement for the use of ethidium-bromide and other DNA stains for visualizing DNA in gels.
Interpret the results of PCR and restriction enzyme digestion based on an observed band pattern on agarose gel.

Laboratory exercise 3 - Vector and insert purification

By the end of the 3rd laboratory class, students should be able to independently:
Purify any DNA fragment from agarose gel following agarose gel electrophoresis.
Estimate the integrity, purity, and quantity of isolated DNA fragment(s).

Laboratory exercise 4 - Ligation and transformation

By the end of the 4th laboratory class, students should be able to:
Independently set-up and perform a DNA ligation reaction.
Independently set-up and perform transformation of competent *E. coli* cells with foreign DNA.
Evenly plate bacterial cell from liquid culture onto solid agar plates.

Laboratory exercise 5 - Phenotypic and molecular analysis of transformants I

By the end of the 5th laboratory class, students should be able to independently:
Plan and perform gel electrophoresis of plasmid DNA isolated from obtained transformants.
Identify the putative positive clones suitable for further analysis based on the electrophoretic pattern of isolated plasmid DNA molecules.

Laboratory exercise 6 - Phenotypic and molecular analysis of transformants II

By the end of the 6th laboratory class, students should be able to independently:
Plan and perform restriction digestion and gel electrophoresis of digested plasmid DNA to identify the clones carrying the insert in the correct orientation

Laboratory exercise 7 - Phenotypic and molecular analysis of transformants III

By the end of the 7th laboratory class, students should be able to independently:
Plan and execute construction of a recombinant plasmid DNA molecule.

Student obligations:

Pohađanje nastave i aktivno sudjelovanje u predavanjima i vježbama.

Exam (exam taking, description of the written/oral/practical part of the exam, point distribution, grading criteria):

Ocjenjivanje studenata provodi se prema važećem Pravilniku o studijima Sveučilišta u Rijeci, te prema Pravilniku o ocjenjivanju studenata na Medicinskom fakultetu u Rijeci (usvojenom na Fakultetskom vijeću Medicinskog fakulteta u Rijeci). Ocjenjivanje studenata vrši se primjenom ECTS (A-E) i brojčanog sustava (1-5). Ocjenjivanje u ECTS sustavu izvodi se apsolutnom raspodjelom, te prema dodiplomskim kriterijima ocjenjivanja. Studenti tijekom nastave mogu prikupiti 70%, a na završnom ispitu 30% od konačne ocjene.

Ispitna razdoblja i prijava ispita

Prvi ispitni termin za završni test biti će odmah po završetku nastave.

Ispiti se prijavljuju u ISVU sustavu.

Ostali ispitni termini će biti navedeni u na mrežnim stranicama Centra.

Other notes (related to the course) important for students:

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COURSE HOURS 2025/2026

Basics of Genetic Engineering

Lectures (Place and time or group)	**Practicals** (Place and time or group)
23.04.2026	
Lecture 1 - Introduction to genetic engineering: • P09 - TEACHING IN ENGLISH (16:00 - 17:30) [192] ◦ BOGE Lecture 2 - Enzymes in genetic engineering: • P09 - TEACHING IN ENGLISH (17:30 - 19:00) [192] ◦ BOGE	
dr. sc. Lisnić Berislav, dipl. ing. [192]	
28.04.2026	
Lecture 3 - Vectors for gene cloning: • P09 - TEACHING IN ENGLISH (16:00 - 17:30) [192] ◦ BOGE	
dr. sc. Lisnić Berislav, dipl. ing. [192]	
04.05.2026	
Lecture 4 - Polymerase chain reaction (PCR): • P08 (08:00 - 09:30) [192] ◦ BOGE	
dr. sc. Lisnić Berislav, dipl. ing. [192]	

List of lectures, seminars and practicals:

LECTURES (TOPIC)	Number of hours	Location
Lecture 1 - Introduction to genetic engineering	2	P09 - TEACHING IN ENGLISH
Lecture 2 - Enzymes in genetic engineering	2	P09 - TEACHING IN ENGLISH

Lecture 3 - Vectors for gene cloning	2	P09 - TEACHING IN ENGLISH
Lecture 4 - Polymerase chain reaction (PCR)	2	P08
Lecture 5 - Hybridization-based nucleic acid assays	1	
Lecture 6 - Sequencing of genes and genomes	2	
Lecture 7 - Applications of genetic engineering	2	

PRACTICALS (TOPIC)	Number of hours	Location
Laboratory exercise 1 - Introductory class	1	
Laboratory exercise 2 - Vector and insert preparation	3	
Laboratory exercise 3 - Vector and insert purification	2	
Laboratory exercise 4 - Ligation and transformation	2	
Laboratory exercise 5 - Phenotypic and molecular analysis of transformants I	2	
Laboratory exercise 6 - Phenotypic and molecular analysis of transformants II	1	
Laboratory exercise 7 - Phenotypic and molecular analysis of transformants III	1	

EXAM DATES (final exam):