GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	GENETIC ENGINEERING, PG_00066804		
Field of study	Biotechnology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Faculty Of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Paweł Sachadyn	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	15.0	0.0	60

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	60	5.0	35.0	100

Subject objectives

The aim of lecture is to broden the knowledge of students on genetic engineering apllications in research and industry.

The aim to project is to design and perform an experiment of molecular cloning in silico .

The aim of laboratory is to carry out an experiment of in vitro cloning of an animal gene to a bacterial plasmid vector.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U01] designs experiments in accordance with the state of the art and the latest scientific literature, using computer methods of data analysis, computer simulations	The student can design and experiment with molecular cloning with the use of a vector plasmid	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K7_U07] evaluates the possibility of commercialization of a product or technology based on the analysis of scientific publications and patents	The student is aware of ethical and bioethical requirements in the work of a biotechnologist in science and industry	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject
[K7_K101] acknowledges the importance of knowledge related to the field of study in solving cognitive and practical problems, critically assessing the information obtained	Using reliable sources, the Student can find and interpret information on the development and applications of genetic engineering	[SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work
[K7_W03] selects methods using living organisms and biomolecules to produce and process consumer goods	The student can select a solution in the field of genetic engineering to obtain proteins for research, medical or industrial applications	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects

Subject contents	LECTURE key techniques and applications of genetic engineering 1 Molecular cloning - vectors, inserts and ligation techniques. 2. Genetic engineering of mammalian cells in tissue cultures. 3. Induced pluripotent stem cells. 4. Humanised antibodies and human antibodies. 5. Animal genetic engineering - the technique of genetic modification of animals. Knockout and transgenic animals in research. 6. Genome editing. CrispR and other methods. Genetic modification in selected tissues. Tissue-specific gene expression. Cre-lox method. 7. Gene therapy - methods and challenges. 8. Plant genetic engineering -methods, potential and challenges LABORATORY - in vitro cloning into a plasmid vector in E. coli cells. 1. RNA extraction from solid tissues 2. cDNA synthesis. 3. PCR gene amplification on cDNA template. 4. Plasmid DNA vector (pUC19) extraction. 5. Insert preparation: extraction of PCR-amplified DNA fragment from an agarose gel band (gel-out). 6. Vector and insert DNA digestion with restriction enzymes. 7. DNA purification after enzymatic reactions (clean-up). 8. Ligation of insert and vector DNA. 9. Transformation of competent cells with ligation mixture. Blue-white screening on IPTG and X-Gal solid medium and culturing selected clones on liquid medium 10. Restriction analysis of recombinant plasmids. PROJECT - In silico cloning. 1. Selection of gene, template source and the nucleotide sequence for cloning

	2. Selection of restriction enzymes 3. Design of primers and PCR reaction for insert amplification; identification of the correct nucleotide sequence of the insert using sequence alignment 4. Computer simulation of vector and insert digestion and ligation 5. Comparison of amino acid sequences of the native and recombinant protein 6. Determination of MW and isoelectric point of the fusion protein 7. Restriction analysis design 8. Computer codons optimisation for heterologous gene expression 9. Design and simulation of Gibson cloning
Prerequisites and co-requisites	basics of molecular biology, genetics, and microbiology

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
laboratory (final report, experiment results)	60.0%	30.0%
final test (test of choice)	60.0%	45.0%
molecular cloning project and presentation	60.0%	25.0%

Recommended reading

Basic literature	lecture print-outs
Supplementary literature	publications cited in the lecture
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	MOLECULAR CLONING LECTURE 1 1. Key steps of molecular cloning. 2. Types of vectors used in molecular cloning. 3. Main applications of molecular cloning. 4. The principle of blue-white selection. 5. Methods of obtaining inserts for cloning. 6. Artificial synthesis of insert DNA disadvantages and advantages. 7. Codon usage - sequence optimisation or host selection (pRARE plasmid in E. coli Rosetta). 8. How to obtain the full nucleotide sequence of the transcript if only part of the sequence is available - the principle of the RACE method. 9. Phage T4 DNA ligase - substrates, cofactor and mechanism of action. 10. DNA topoisomerase I as a ligase - principle of action, types of inserts. 11. Principles of clonase action and benefits of clonase (lambda phage integrase). 12. Ligase -indenpendent cloning (LIC, without DNA ligase). 13. Gibson cloning (Gibson assembly). 14. Transformation vs. transfection.
Work placement	Not applicable

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