GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Tissue and genetic engineering, PG_00068810		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Optional subject group Specialty subject group Subject group related to scientific research 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	exam
Conducting unit	Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Piątek	
	Teachers		

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	15.0	0.0	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	6.0	34.0	100

Subject objectives	The aim of the course is to familiarize the student with the basic techniques of genetic and tissue engineering applied in biomedical engineering. The aim of the course is to draw attention to the physical and chemical foundations of the discussed techniques and to draw attention to further possibilities of their development. The ethical aspects of using some methods are also discussed.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U53] can apply advanced equipment used in biomedical diagnostics	The student is able to use the equipment used in selected aspects of medical diagnostics, e.g. PCR reaction, fluorescence microscopy, immunological methods.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
[K7_K01] is ready to create and develop models of proper behaviour in the work and life environment; undertake initiatives; critically evaluate actions of their own, teams and organisations they are part of; lead a group and take responsibility for its actions; responsibly perform professional roles taking into account changing social needs, including: - developing the achievements of the profession, - observing and developing rules of professional ethics and acting to comply to these rules	The student works in a group. The student develops social behavior related to teamwork. The student knows the ethical aspects related to the use of biomedical engineering methods.	[SK2] Assessment of progress of work [SK1] Assessment of group work skills [SK5] Assessment of ability to solve problems that arise in practice [SK3] Assessment of ability to organize work
[K7_W54] knows and understands in-depth selected aspects of biomedical engineering, in particular chemistry, biochemistry, biomaterials and materials science, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences	The student understands the interrelationships between biochemistry, molecular biology, chemistry, and materials science in the field of biomedical engineering concerning cell and tissue culture.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation

Subject contents	Course content – lecture Lecture Genetic engineering: 1. Introduction to the use of genetic engineering in modern biomedical engineering. 2. DNA modifications - restriction enzymes and DNA ligation. 3. DNA replication as the basis of the in vitro nucleic acid amplification technique, PCR. PCR as a diagnostic method. 4. Plasmids as a basic tool in the creation of recombinant bacterial organisms. 5. Biotechnological production of proteins of medical importance. 6. Fundamentals of DNA sequencing techniques and modern methods of genome sequencing. Ethical aspects resulting from the sequencing of the human genome. 7. siRNA technology - mechanism, application, ethical aspects. 8. CRISPR technology - mechanism, application, ethical aspects. Tissue engineering: 1. Tissue engineering - definition and scope of the subject. 2. Genetic basis of tissue differentiation. 3. Genetic basis of histocompatibility. 4. Basic assumptions concerning the culture of animal tissues and cells. 5. In vitro methods of cell and tissue culture - a detailed aspect. 6. Tissue cultures as a source of recombinant proteins - genetic basis for the functioning of tissue expression systems. 7. Modern materials in biomedical engineering of tissues and organs. 8. Bacterial and plant biomaterials in genetic engineering. Exercises and laboratory The exercises and the laboratory are conducted jointly, interpenetrating each other. 1. Isolation of plasmd DNA from bacteria. Chemical and physical properties of nucleic acids as the basis for methods of their purification. DNA isolation of pUC19 plasmid. 2. Restriction enzymes and DNA ligases - enzymatic modification of nucleic acids. Digestion of plasmid pUC19 with SmaI and HindIII enzymes.

	3. In silico design of a process for the construction of the recombinant plasmid pUC19-DraE. 4. Reaction of nucleic acid amplification. Amplification of the gene encoding the bacterial DraE adhesin protein. 5. In silico design of the pET30-DraE recombinant plasmid construction process. 6. Construction of the recombinant plasmid pUC19-DraE - ligation reaction. Transformation of E. coli BL21DE3 cells with the pET30-GFP plasmod. 7. Transformation of Top10 cells with ligation mixture containing plasmid pUC19-DraE. 8. Acquainting with the basic methods of cultivating eukaryotic cells. 9. Establishing and culturing human bladder cell lines. 10. The use of immunofluorescence microscopy to study the adhesion of E. coli Dr + -GFP bacteria to the human bladder cell line. 11. Examination of the ability of E. coli bacteria to form a biofilm on various polymers used in medical engineering.
Prerequisites and co-requisites	Basic knowledge of biochemistry and chemistry.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exercises and laboratory grade	60.0%	50.0%
Lecture grade	60.0%	50.0%

Recommended reading

Basic literature	Various types of materials attached to the content of the course on the eNauczanie platform.
Supplementary literature	No.
eResources addresses	

Example issues/ example questions/ tasks being completed	Examples of laboratory and exercise topics: 1. Isolation of plasmid DNA from bacteria. 2. Cutting DNA with restriction enzymes. 3. In silico design of a recombinant plasmid construction process. 4. DNA amplification. 5. Eukaryotic cells cultures. Sample lecture questions: 1. What is the mechanism of restriction enzymes? 2. What is the DNA replication mechanism? 3. How does the PCR reaction work? 4. What are the components of the PCR reaction? 5. What is the difference between the siRNA and CRISPR techniques? 6. What methods are used to sequence genomes?
Practical activites within the subject	Not applicable

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