GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Introduction to Contemporary Biotechnology, PG_00054676		
Field of study	Biotechnology		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Microbiology -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Beata Zalewska-Piątek	
	Teachers	dr hab. Beata Zalewska-Piątek	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	0.0	30

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	30	2.0	18.0	50

Subject objectives

The aim of lecture is transmission of knowledge in the field of leading development directions in biotechnology.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W08	Student knows how to use available technical and biotechnological solutions for designing of diagnostic tests. Student knows how to apply variety of biotechnological methods during designing and production of vaccines, chemotherapeutics and diagnostic tests. Student has ability of critical evaluation of available biotechnological tools and engineering activities from economical point of view. Student is familiar with biotechnological utilization of microbiota in medicine.	[SW1] Assessment of factual knowledge
K6_U08	Student knows branches of biotechnology and how to divide them based on color codes (red, white, green and other colors biotechnology). Student understands wide possibilities of biotechnology use in medicine, pharmacy, industry, agriculture and environmental protection. Student is getting familiar with types of research and business laboratories. Student acquires knowledge from basic research diagnostic tests and possibilities of using them in the environmental and health protection.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	The history of the birth of Biotechnology, its development and contemporary division - Colors of Biotechnology. **Lecturer: dr hab. inż. Hubert Ciesliński, prof. uczelni** Insects as model organisms on the example of *Galleria mellonella* larvae. **Lecturer: dr inż. Martyna Mroczyńska-Szeląg** **Mammalian regeneration parts 1 and 2**. The nature of tissue and organ regeneration, the prospects of regenerative medicine, unusual regenerative phenomena in vertebrates and invertebrates, and the limitations and regenerative possibilities observed in mammals. **Lecturer: Prof. dr hab. inż. Paweł Sachadyn** **Mammalian regeneration part 3**. Innovative concepts of pharmacological activation of regeneration and the importance of epigenetic regulation for regenerative potential. **Lecturer: Prof. dr hab. inż. Paweł Sachadyn** **Microorganisms as microbial factories, part 1**. Historical overview of human use of the microorganisms in the production of consumer goods: from antiquity to the time of Louis Pasteur (the birth of biotechnology). Introduction to modern biotechnology - the concept of an organism cell as a "living biotechnology factory". Division of the biotechnological processes according to the classes of target products. 1. Microorganisms as producers of macromolecules, e.g., enzymes of industrial importance. 2. Microorganisms as producers of low molecular weight compounds, e.g., organic acids, alcohols, amino acids, antibiotics and other chemotherapeutic agents, and dyes. 3. Biomass of microorganisms as an industrial bioproduct, e.g., biomass production for the purposes of feed production, yeast for bakery. 4. *In situ* application of microorganisms in biotransformation processes, including bioremediation, industrial wastewater treatment and in biorefining processes, e.g., metal ores. **Lecturer: dr hab. inż. Hubert Cieśliński, prof uczelni** **Microorganisms as microbial factories, part 2.** Presentation of the possibilities of using biotechnology in medicine and industry: 1. General overview of systems used for the production of recombinant proteins (bacteria, yeast, animal cells and transgenic plants). 2. Discussion of the advantages of yeast as producers of heterologous proteins and presentation of the most important yeast species used for the production of recombinant proteins on an industrial scale. 3. Presentation of examples of biopharmaceuticals produced by recombinant yeast, i.e., human hormones (insulin and its analogues, growth hormone), cytokines or vaccine antigens. 4. Presentation of examples of the use of recombinant yeast for the production of low molecular weight compounds, for example the low-calorie sweetener tagatose.

	5. Presentation of examples of the use of recombinant yeast for the production of biofuels - ethanol from lignocellulosic biomass hydrolysate. **Lecturer: dr hab. inż. Marta Wanarska, prof. uczelni (2 hours)** **Extremophilic microorganisms and their importance for the development of biotechnology** Definition of extremophilic microorganisms (organisms). Criteria for the division of extremophiles into groups: thermophiles, psychrophiles and psychrotolerants, halophiles, acidophils, basophils or basophiles. The importance of research on extremophiles for the development of biological sciences. The importance of research on extremophilic organisms for the development of modern biotechnology. The extremophiles and their enzymes as an alternative to the development of biotechnological processes alternative to: a) technological processes of the chemical industry (chemical reactions under "harsh conditions"), b) biotechnological processes carried out with the use of non-extremophilic mesophilic microorganisms. **Lecturer: dr hab. inż. Hubert Cieśliński, prof. uczelni** **Folate metabolism and selected human diseases.The contribution of genetic variants to the risk of certain human diseases.** Presentation of the problems of genetic analyses in population studies. Introducing the concept of a genetic variant. Examples of analyses aimed at determining the contribution of selected factors, including genetic ones, in the etiology or course of selected human diseases. Interpretation of the presented analyses. **Lecturer: dr hab. n. med. Anna Stanisławska-Sachadyn, prof. uczelni (2 hours)** **Molecular diagnostics.** The subject of research, basic techniques, types of laboratories in which molecular diagnostic tools are used. The application of various diagnostic tools, e.g., for forensic research. **Lecturer: dr hab. Beata Krawczyk, prof. uczelni** **The human microbiome**. The concept of microbiota, metagenome and microbiome, research methods used in the qualitative and quantitative analysis of microbiota, the importance of microbiota in human health. Biotechnological use of microbiota. **Lecturer: dr hab. Beata Krawczyk, prof. uczelni** **Recombinant proteins - biotechnological production and application.** Difference between "wild type" protein and recombinant protein. Obtaining recombinant proteins (production steps, expression systems, vectors). Application of recombinant proteins in medicine (especially for *in vitro* diagnostics). Types and principles of basic diagnostic methods based on recombinant proteins. Benefits of using recombinant proteins in diagnostics. **Lecturer: dr hab. inż. Lucyna Holec-Gąsior, prof. uczelni** **Alternative strategies for the treatment and prevention of urinary tract infections (UTIs)** caused by uropathogenic strains of *E. coli* (UPEC) - from vaccines to innovative chemotherapeutic agents. UTI issues, etiological factors and types of infections. Mechanisms of pathogenicity of UPEC strains. Adhesins of the conserved chaperone-usher secretion system. Live and attenuated vaccines. Adhesin based vaccines (adhesin/chaperone protein complexes, native and chimeric pili/fimbriae). Plicides as an alternative group of UTI therapeutic agents. **Lecturer: dr hab. inż. Rafał Piątek/ dr hab. Beata Zalewska-Piątek, prof. uczelni** **Verification tests.** Lecturer: **dr hab. Beata Zalewska-Piątek, prof. uczelni**
Prerequisites and co-requisites	The student should have basic knowledge of biology and chemistry.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Quiz	60.0%	100.0%

Recommended reading	Basic literature	1: Podstawy Biotechnologii. Pod redakcją: Ratledge C., Kristiansen B. Wydawnictwo PWN, 2017.2: Podstawy Wybranych Procesów Biotechnologicznych. Fiedurek J. Wydawnictwo UMCS, 2004.3: Sass P, Sosnowski P, Podolak-Popinigis J, Górnikiewicz B, Kamińska J, Deptuła M, Nowicka E, Wardowska A, Ruczyński J, Rekowski P, Rogujski P, Filipowicz N, Mieczkowska A, Peszyńska-Sularz G, Janus Ł, Skowron P, Czupryn A, Mucha P, Piotrowski A, Rodziewicz-Motowidło S, Pikuła M, Sachadyn P. Epigenetic inhibitor zebularine activates ear pinna wound closure in the mouse. EBioMedicine. 2019 Aug;46:317-329. DOI: 10.1016/j.ebiom.2019.07.010.4: Stanisławska-Sachadyn A, Borzyszkowska J, Krzemiński M, Janowicz A, Dziadziuszko R, Jassem J, Rzyman W, Limon J. Folate/homocysteine metabolism and lung cancer risk among smokers. PLoS One. 2019 Apr 2;14(4):e0214462. DOI: 10.1371/journal.pone.0214462.5: Kotlowski R, Bernstein CN, Sepehri S, Krause DO. High prevalence ofEscherichia coli belonging to the B2+D phylogenetic group in inflammatory bowel disease. Gut. 2007 May;56(5):669-75. DOI: 10.1136/gut. 2006.099796.6: Olszewski M, Grot A, Wojciechowski M, Nowak M, Mickiewicz M, Kur J. Characterization of exceptionally thermostable single-stranded DNA-binding proteins from Thermotoga maritima and Thermotoga neapolitana. BMC Microbiol. 2010Oct 15;10:260. DOI: 10.1186/1471-2180-10-260.7: Holec-Gąsior L, Ferra B, Czechowska J, Serdiuk IE, Krzymiński K. A novel chemiluminescent immunoassay based on original acridinium ester labels as better solution for diagnosis of human toxoplasmosis than conventional ELISA test. Diagn Microbiol Infect Dis. 2018 May;91(1):13-19. DOI: 10.1016/j.diagmicrobio. 2017.12.022.8: Zalewska B, Piatek R, Konopa G, Nowicki B, Nowicki S, Kur J. Chimeric Dr fimbriae with a herpes simplex virus type 1 epitope as a model for a recombinant vaccine. Infect Immun. 2003 Oct;71(10): 5505-13. DOI: 10.1128/iai.71.10.5505-5513.2003.9: Krawczyk B, Samet A, Leibner J, Sledzińska A, Kur J. Evaluation of a PCR melting profile technique for bacterial strain differentiation. J Clin Microbiol. 2006 Jul;44(7):2327-32. DOI: 10.1128/JCM.00052-06.10: Cieśliński H, Długołecka A, Kur J, Turkiewicz M. An MTA phosphorylase gene discovered in the metagenomic library derived from Antarctic top soil during screening for lipolytic active clones confers strong pink fluorescence in thepresence of rhodamine B. FEMS Microbiol Lett. 2009 Oct;299(2):232-40. DOI: 10.1111/j.1574-6968.2009.01756.x.11: Wanarska M, Kur J. A method for the production of D-tagatose using a recombinant Pichia pastoris strain secreting -D-galactosidase from Arthrobacter chlorophenolicus and a recombinant L-arabinose isomerase from Arthrobacter sp.22c. Microb Cell Fact. 2012 Aug 23;11:113. DOI: 10.1186/1475-2859-11-113.12: Kur J, Koob M, Burkiewicz A, Szybalski W. A novel method for converting common restriction enzymes into rare cutters: integration host factor-mediated Achilles' cleavage (IHF-AC). Gene. 1992 Jan 2;110(1):1-7. DOI: 10.1016/0378-1119(92)90437-t.
	Supplementary literature	1: Biotechnology and Chemistry of Antibiotics. Chmiel A., Grudziński S., PWN, 1998.
	eResources addresses	Adresy na platformie eNauczanie: WPROWADZENIE DO WSPÓŁCZESNEJ BIOTECHNOLOGII - nowy 2024/2025 - Moodle ID: 27711 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=27711
Example issues/ example questions/ tasks being completed	1. Microbiom means:a) Bacteria, Eukaryota and viruses populated human organism;b) genes and genomes of microbiota containing plasmids, indicating genetic petential of population;c) genes and genomes of microbiota including host metabolism products;d) microorganisms species in the human GI-tract.2. Grey biotechnology means:a) industrial applications of biotechnology;b) application of biotechnological methods in medicine;c) application of biotechnology in agriculture and food production;d) application of biotechnology in environmental protection.	
Work placement	Not applicable	