GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Chemistry of Proteins and Nucleic Acids, PG_00037518						
Field of study	Biotechnology						
Date of commencement of studies	October 2023		Academic year of realisation of subject	2026/2027			
Education level	first-cycle studies		Subject group	Optional 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	4		Language of instruction	Polish			
Semester of study	7		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	assessment			
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	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	Introduction to protein and nucleic acid structure and function.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U02	The student is able to apply the knowledge of physical, inorganic, organic and quantum chemistry to predict the properties and functions of proteins and nucleic acids.	[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information
K6_W02	The student has knowledge of physical, inorganic, organic, and quantum chemistry as it relates to the structure and function of proteins and nucleic acids.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
K6_W06	The student knows and understands the relationships between the structure and properties of proteins and nucleic acids and the mechanisms involved in molecular biology, cell biology, immunology, and enzymology, in particular: 1. Understands the impact of molecular crowding on the specificity and efficiency of enzymes used in molecular biology, 2. Understands the relationship between the structure of antibodies and their function, including basic strategies for their modification, 3. Understands the concept of protein homeostasis and its role in processes leading to the formation of protein amyloids, 4. Understands how the protein folding process depends on external factors and knows how to modulate it under in vitro and in vivo conditions.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Physicochemical properties of amino acids: characteristics of side chains, chirality. Peptide bondelectronic structure, torsion angles, and their permissible values (Ramachandran plot). Secondary structures of proteins: helices (α, 3, π), β-sheets (parallel, anti-parallel, mixed), and loop structures; stabilization by hydrogen bonds, van der Waals interactions, and the hydrophobic effect. Dipole moment of the α-helix, twist of β-sheets. Interactions between secondary-structure elements (helixhelix: knobs into holes, ridges in grooves; helixsheet; sheetsheet) as a result of contact optimization. Representations of secondary structures and topological diagrams of tertiary structures.
Motifs (supersecondary) and domains as basic structural and functional units. Tertiary structure: α-domains (coiled-coil, four-helix bundle; examples: GCN4, cytochrome b562, Rop protein; hemoglobin, muramidase), α/β domains (TIM barrel triose phosphate isomerase, methylmalonyl-CoA mutase, pyruvate kinase; α/β open-book structures Rossmann motif; saddle structures), and β domains (anti-parallel barrels RBP, SOD; Greek key and jelly roll motifs; examples: influenza virus neuraminidase and hemagglutinin).
Thermodynamic basis of protein stability: the hydrophobic effect as the driving force of folding; parameters ΔH, ΔS, Cp; denaturation (including cold denaturation); DSC technique.

Nucleic acids structure and function. Ribozymes structure, mechanism of action, and applications. Chemical synthesis of peptides and nucleic acids.

Prerequisites and co-requisites

Fundamentals of biochemistry and physical chemistry.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture - the final evaluation includes an oral examination.	60.0%	100.0%

Recommended reading

Basic literature	A.Fersht, Structure and Mechanism in protein science, Freeman 2000. A.Cooper, Biophysical Chemistry, RSC 2004. C.Branden & J.Tooze, Introduction to protein structure, Garland 1999.
Supplementary literature	No requirements
eResources addresses	

Example issues/ example questions/ tasks being completed	How does thermodynamics determine the protein folding process? How do non-covalent interactions determine protein folding? How does the hydrophobic effect determine the protein folding? How do properties of peptide bond and amino acid residues affect the folding, structure and function of proteins? How is enzymatic catalysis related to the structure of proteins? How does the external environment determine the structure and function of biomacromolecules? How to study the structural and functional properties of biomacromolecules? How to create recombinant proteins of biotechnological importance?
Practical activites within the subject	Not applicable

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