GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Supramolecular chemistry and medicine, PG_00053339		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Ewa Wagner-Wysiecka	
	Teachers	prof. dr hab. inż. Ewa Wagner-Wysiecka dr inż. Radosław Pomećko dr hab. inż. Robert Tylingo dr inż. Agata Sommer	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	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	3.0	42.0	75

Subject objectives

The aim of the course is to familiarize students with the broadly understood aspects of the interdisciplinary field of science - supramolecular chemistry - with particular emphasis on application areas in medicine and related sciences.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_K02] is ready to provide critical evaluation of received content and to acknowledge the importance of knowledge in solving cognitive and practical problems	The student interprets the results of the obtained research, drawing constructive conclusions in relation to the data presented in the world literature	[SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	Student is able to prepare a design concept illustrating the use of modern supramolecular chemistry in medicine	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task

Subject contents

Course content – lecture

Lecture: Definition of supramolecular chemistry. Types of complexing molecules; the concepts of ligand, substrate, receptor, host, guest. Types of interactions in supramolecular systems. Examples of synthetic host molecules, complexing compounds (podandss, coronands, cryptands, spherands, calixarenes, hetero- and homo-calixarenes, metalloporphyrins and others). The complexation of cations, anions and molecules. Effects: chelate, macrocyclic and cryptic. Pearson's theory of hard and soft acids and bases (HSAB). Strategy for the synthesis of macrocyclic compounds. Factors promoting cyclization (template effect, preorganization of substrate molecules, dilution method). Self-organization and molecular recognition. Chemistry of macromolecules (polymers), basic properties of macromolecules, types of polymerization reactions. Macrocyclic ligands: cyclodextrines and their complexes, dendrimers, cyclophanes and steroids. The phenomenon of preorganization, systems containing a large number of hydrogen bonds (rosettes, tapes - ribbons, fibers and two-dimensional networks, capsules with hydrogen bonds, gas hydrate clathrates). Supramolecular interactions exemplified with polysaccharide biopolymers (chemistry of chitosan, alginate, starch), protein biopolymers (collagen, fibrinogen). Self-organization of nucleic acids (DNA and RNA chemistry), types of supramolecular interactions occurring in biopolymers and the possible uses of these interactions. Intermediate systems between chemical molecules and cells of living organisms, lipid membranes, microemulsions, micelles, fibers, nanotubes, liquid crystals Examples of the application of supramolecular chemistry in the food and cosmetics industries.Supramolecular systems occurring in nature (biological systems) and their role; examples of natural complexing compounds (antibiotics, siderophores, etc.). Supramolecular biomimetic systems: enzymes, cells, channels. Applications of supramolecular chemistry in medicine: a) diagnostics - optical and fluorescent sensors, logic gates, electrochemical sensors, imaging systems; multifunctional nanoparticles b) therapeutics - chelate therapy, drug delivery and controlled release systems, supramolecular antibiotics.(Nano)Molecular machines.

Laboratory:

1. Modification of bacterial cellulose for imparting antimicrobial properties.

2. Immobilization techniques of bioactive materials used in medicine - encapsulation polysaccharide-based hydrogel

3. Supramolecular interactions in constructing III generation dressings

4. Supramolecular polymers interactions used in 3D-bioprinting

5. Supramolecular analytical chemistry - applications in biomedical analysis

Prerequisites and co-requisites

Knowledge and skills (applies also to the practical part of the subject - laboratory) in the field of organic, analytical, physical chemistry, and biochemistry.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Performing of the laboratory classes and passing tests	100.0%	50.0%
colloquium on the lecture material (written or oral)	51.0%	50.0%

Recommended reading

Basic literature	1. Jonathan W. Steed, David R. Turner, Karl Wallace: "Core Concepts in Supramolecular Chemistry and Nanochemistry", Willey 2009 2. Katsuhiko Ariga, Toyoki Kunitake: "Supramolecular Chemistry - Fundamentals and Applications: Advanced Textbook", Springer Science & Business Media, 2006 3. Peter J. Cragg" "From Biological Inspiration to Biomedical Applications" Springer Science+Business Media B.V. 2010 4. "Wybrane aspekty chemii supramolekularnej", Praca zbiorowa pod redakcją Grzegorza Schroedera, BETAGRAF P.U.H. Poznań 2009 5. "Kompleksy typu gość-gospodarz" red. Grzegorz Schroeder, SERIA: Chemia Supramolekularna, BETAGRAF Poznań, 2003 6. Aktualne pozycje literatury światowej zamieszczane w materiałach wykładowych
Supplementary literature	1. Grzegorz Schroeder, Joanna Wyrwał: "Maszyny molekularne", SERIA: Chemia Supramolekularna, BETAGRAF Poznań 2004 2. Błażej Gierczyk, Joanna Kurczewska, Grzegorz Schroeder, "Pracownia z chemii supramolekularnej. Fizykochemia receptorów molekularnych", Poznań 2008 3. Materiały supramolekularne Praca zbiorowa pod redakcją Grzegorza Schroedera, BETAGRAF P.U.H. Poznań 2008
eResources addresses	

Example issues/ example questions/ tasks being completed	Describe the basic relationships characteristic for guest-host chemistry. List and illustrate with examples the types of interactions in supramolecular systems (giving examples of sytems occurring in nature and synthetic ones). Discuss drug delivery and controlled release systems based on supramolecular interactions.
Practical activites within the subject	Not applicable

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