



Subject card

Subject name and code	Metals and their compounds in medicine, PG_00069255						
Field of study	Chemistry						
Date of commencement of studies	February 2025		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		Subject group				
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		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Inorganic Chemistry -> Faculty of Chemistry -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Anna Dołęga				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	20.0	0.0	10.0	45
	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	45		5.0		25.0	75
Subject objectives	The aim of the course "Metals and Their Compounds in Medicine" is to familiarize students with the structure, physicochemical properties, and methods of obtaining metal compounds used in medicineincluding cosmetology. The course is designed to highlight the importance of metals and their compounds in the context of their application as components of pharmaceuticals, diagnostic agents, and cosmetic products. Particular emphasis is placed on understanding the chemical structures, reactivity, stability, toxicity, as well as the techniques of synthesis and characterization of these compounds.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_K01] is aware of the problems related to the profession of a chemist, is able to assess the effects of the activity performed	The student understands the ethical, environmental, and societal implications of chemical work in medical and cosmetic contexts and can critically evaluate the outcomes of their actions in professional practice.	[SK5] Assessment of ability to solve problems that arise in practice
	[K7_U02] prepares detailed documentation of the results of independently conducted experiments and analyzes the obtained results, uses professional vocabulary with understanding and prepares and communicates information	The student can independently conduct experiments, record results precisely, interpret data using appropriate chemical terminology, and clearly communicate findings both in writing and orally.	[SU1] Assessment of task fulfilment
	[K7_K02] is able to cooperate and work in a group, taking on different roles	The student demonstrates the ability to effectively participate in group work, taking on different roles as needed, while contributing to shared goals in laboratory or research settings.	[SK1] Assessment of group work skills
	[K7_U82] is able to proficiently obtain and process information related to field of study and academic environment in foreign language at B2+ level of the Common European Framework of Reference for Languages (CEFR)	The student is proficient in searching for, interpreting, and utilizing scientific literature and sources in English, particularly in the context of chemistry and its medical applications.	[SU5] Assessment of ability to present the results of task
	[K7_K03] plans and performs the synthesis of chemical compounds with the required properties	The student is capable of designing and executing synthetic procedures to obtain metal compounds with specific functional attributes, taking into account reactivity, stability, and safety considerations.	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W04] indicates methods for the synthesis of chemical compounds with defined properties	The student is able to select and describe appropriate synthetic methods for obtaining metal-containing compounds with targeted physicochemical and biological properties relevant to medical and cosmetic applications.	[SW1] Assessment of factual knowledge

Subject contents

Lecture:

1. Introduction to the chemistry of metals and their complexes basic concepts
2. Medical applications of metals and their alloys
3. Methods of synthesizing metal compounds overview of techniques. Synthesis of coordination complexes. Preparation of oxides, salts, and organometallics. Principles of working with metals and organometallic compounds.
4. Characterization of metal compounds instrumental techniques. UV-Vis, IR, NMR, EPR, XRD, TGA, DSC spectroscopy. Microscopy and surface analysis (SEM, TEM).
5. Metal oxides in cosmetology properties and applications. Zinc, titanium, iron, aluminum, and magnesium oxides. Functions: pigments, UV filters, mattifying agents.
6. Metal complexes as components of skincare cosmetics. Metal chelates in cosmetics. Formula stabilization, active ingredient delivery.
7. Metal compounds in medicinal products and pharmacotherapy. Applications of platinum, bismuth, gold, silver, lithium, gallium.
8. Examples of metal-containing drugs (e.g., cisplatin, auranofin)
9. Use of metal compounds in medical diagnostics. Organometallic contrast agents (Gd, Tc, Re), diagnostic tracers and probes.
10. Safety and toxicity of metal compounds. Toxicology of heavy metals. Legal regulations (REACH, EU Cosmetics Regulation).
11. Modern organometallic materials in medicine and cosmetology: MOFs, metal nanoparticles, bioactive complexes. Research perspectives and challenges.

Laboratory:

Exercise 1: Synthesis of silver or gold nanoparticles as antibacterial agents

Objective: To obtain stable noble metal nanoparticles via chemical reduction; discuss their antimicrobial mechanism of action.

Steps:

1. Synthesis of Ag or Au nanoparticles using reducing agents (e.g., sodium citrate)
2. Observation of plasmon effect (color change) and UV-Vis spectrum measurement
3. Discussion of potential applications in cosmetic and medicinal preparations

Exercise 2: Synthesis of potassium aluminum sulfate ($KAl(SO_4)_3 \cdot 12H_2O$) as an astringent agent

Objective: Crystallization of alum from aqueous solutions and analysis of its physicochemical properties.

Steps:

1. Preparation of potassium and aluminum salt solutions (from metallic aluminum)
2. Crystallization and purification of the product
3. Characterization of alum-type compounds astringent and antiperspirant properties applications in cosmetics (deodorants, powders)

Exercise 3: Synthesis of bismuth gallate ($Bi_2O_3 \cdot 3Ga_2O_3$) and its spectroscopic analysis (UV, IR, NMR)

Objective: To obtain a bismuth complex with anti-inflammatory and antiseptic properties and identify it using spectroscopic methods.

Steps:

1. Synthesis of bismuth gallate using gallic acid and bismuth(III) salts
2. Structural and bonding analysis (IR, UV-Vis, and 1H NMR spectra if solubility allows)
3. Discussion of therapeutic properties and use as a dermatological powder

	Seminar: The aim of the seminar classes is to develop skills in analyzing and interpreting scientific publications related to metal compounds used in medicine and cosmetology. Students learn to read critically, assess the quality of scientific data, and present and discuss research results in a clear and factual manner. Steps: 1. Selection of a scientific article (approved by the instructor) from a JCR or Scopus-listed journal 2. Preparation of a presentation (1015 minutes) discussing: • The aim and topic of the research • The synthesis and characterization methods used • Main results and their practical significance • Evaluation of the quality of data and the authors' conclusions 3. Presentation to the group 4. Group analysis and discussion example questions: • Were the methods appropriate and sufficiently described? • Were the data well interpreted? • What are the limitations of the study?														
Prerequisites and co-requisites															
Assessment methods and criteria	<table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>presentation</td><td>50.0%</td><td>20.0%</td></tr><tr><td>tests and reports - laboratory</td><td>50.0%</td><td>40.0%</td></tr><tr><td>short written tests - lectures</td><td>50.0%</td><td>40.0%</td></tr></table>	Subject passing criteria	Passing threshold	Percentage of the final grade	presentation	50.0%	20.0%	tests and reports - laboratory	50.0%	40.0%	short written tests - lectures	50.0%	40.0%		
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Recommended reading	<table><tr><td>Basic literature</td><td>Metals in Medicine Author(s): James C. Dabrowiak First published: 13 November 2009 Print ISBN: 9780470681961 Online ISBN: 9780470684986 DOI: 10.1002/9780470684986 Introduction: Metals in Medicine Chemical Reviews 2019, 119, 2, 829-1455</td></tr><tr><td>Supplementary literature</td><td>No</td></tr><tr><td>eResources addresses</td><td></td></tr></table>	Basic literature	Metals in Medicine Author(s): James C. Dabrowiak First published: 13 November 2009 Print ISBN: 9780470681961 Online ISBN: 9780470684986 DOI: 10.1002/9780470684986 Introduction: Metals in Medicine Chemical Reviews 2019, 119, 2, 829-1455	Supplementary literature	No	eResources addresses									
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Example issues/ example questions/ tasks being completed	Given in the part "subject content"														
Work placement	Not applicable														

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