GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	GLASS AND CERAMIC MATERIALS, PG_00064401		
Field of study	Chemistry		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Inorganic Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Anna Dołęga	
	Teachers		

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	2.0	18.0	50

Subject objectives

The aim of the course is to introduce students to the structure, properties, preparation, processing and applications of glass and ceramic materials, as well as to the relationships between their composition, structure, processing conditions and functional properties. The course also aims to develop practical skills in the preparation and modification of selected glass, ceramic and silica materials, characterization of their properties, and interpretation of experimental results using selected instrumental methods.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U09] is able to recognise hazards, counteract them and work with chemical reagents and basic technical apparatus in accordance with health and safety principles and the concept of sustainability	is able to identify and prevent hazards during the preparation and characterization of glass and ceramic materials, using chemical reagents and basic technical equipment in accordance with occupational health and safety regulations and the principles of sustainable development.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task
[K6_U03] operates typical laboratory apparatus and carries out analyses to identify chemical compounds and materials, integrating computational methods and application software	is able to operate standard laboratory equipment and performs analyses for the characterization of glass and ceramic materials, using instrumental and computational methods as well as general-purpose software.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K6_W02] classifies acquired information, assessing its usefulness in solving the posed problems concerning the synthesis and analysis of selected groups of compounds, determining their physical and chemical properties, making measurements and determining the parameters of chemical reactions and processes	has the necessary knowledge to evaluate the relevance of acquired information for solving problems related to the preparation and characterization of glass and ceramic materials, determination of their physical and chemical properties, performing measurements, and determining the parameters of their preparation and modification processes.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture Structure and properties of solids. Crystalline and amorphous solids. Types of bonding in solids: metallic, ionic and covalent bonds. Selected mechanical properties of materials. Glass – structure, properties and types; soda-lime, borosilicate, silica, tellurite and ITO glasses, as well as other specialty glasses. Fundamentals of glass production and forming. Glass-based composite materials – reinforced, laminated and bullet-resistant glass. Amorphous metals (metallic glasses). Ceramic materials – general characteristics; silica materials, silicic acids, silicates and aluminosilicates; traditional and fine ceramics; refractory materials; applications of ceramics in technology and industry. Bioceramics – general characteristics and classification into bioresorbable, bioinert and bioactive materials, including porous materials. Ceramic magnets. Oxide layers on metallic substrates. Superhard materials. Course content – laboratory Preparation and characterization of ordered silica materials. Synthesis of silica materials using surfactants and a silica precursor. Effect of synthesis conditions on the properties of the obtained materials. Investigation of adsorption properties using UV-Vis spectrophotometry. Characterization of the materials by FTIR spectroscopy and analysis of the relationship between their structure and adsorption properties. Preparation of inorganic pigments and glass paints. Preparation of coloured metal compounds by precipitation and thermal treatment. Preparation of a flux and glass paint, application of the paint onto a glass surface, and firing. Evaluation of the effects of pigment type and heat-treatment conditions on the colour, homogeneity, degree of fusion, and adhesion of the resulting coating. Preparation of glass laminates with a polymer interlayer. Preparation of poly(vinyl alcohol) (PVA)-based films and synthesis of poly(vinyl butyral) (PVB) from PVA. Preparation and heat treatment of glass–polymer interlayer–glass laminates. Evaluation of the homogeneity, transparency, and quality of bonding between the layers. Observation of glass behaviour during controlled damage and evaluation of the effect of the polymer interlayer on crack propagation and the displacement of glass fragments. Introduction to industrial ceramic manufacturing technology using tableware porcelain production as an example – a study visit to an industrial plant.
Prerequisites and co-requisites	
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture: Tests during lectures	50.0%	60.0%
Laboratory: test and laboratory reports	50.0%	40.0%

Recommended reading	Basic literature	Kielski A., *Ogólna technologia ceramiki [General Ceramic Technology]*, AGH University of Science and Technology, Kraków. *"Szkło i Ceramika" (Glass and Ceramics)*, quarterly journal, Łukasiewicz Research Network – Institute of Ceramics and Building Materials, ISSN 0039-8144, selected articles.
	Supplementary literature	None
	eResources addresses	

Example issues/ example questions/ tasks being completed	Sample topics: 1. Discuss the structure of glass and explain the differences between crystalline and amorphous solids. 2. Characterize selected types of glass, their properties and applications. 3. Discuss the basic stages of glass production and forming, as well as the factors affecting its properties. 4. Characterize ceramic materials and discuss the relationship between their composition, structure, preparation method and properties. 5. Discuss a selected group of specialty materials covered in the lectures (e.g. bioceramics, metallic glasses, ceramic magnets or superhard materials) and describe their properties and applications. 6. Discuss the preparation of ordered silica materials and explain how their properties can be investigated using UV-Vis and FTIR spectroscopy. 7. Discuss the stages involved in the preparation of an inorganic pigment and glass paint, as well as the factors affecting the properties of the coating after firing. 8. Explain the role of a PVA/PVB polymer interlayer in a glass laminate and its effect on the behaviour of glass upon damage. Sample questions (lecture) 1. Which feature best distinguishes glass from a crystalline solid? A. the presence of covalent bonds only B. the absence of long-range order C. the absence of short-range order D. the presence of only one phase 2. Which type of glass is characterized by increased resistance to sudden temperature changes? A. soda-lime glass B. borosilicate glass C. laminated glass D. reinforced glass 3. The primary function of the polymer interlayer in laminated glass is to: A. increase the melting temperature of the glass B. induce crystallization of the glass C. limit the displacement of glass fragments after breakage D. increase the electrical conductivity of the glass 4. A ceramic material capable of forming a direct bond with tissue is classified as: A. bioinert B. bioresorbable C. bioactive D. superhard 5. Metallic glasses are materials that: A. are ceramic materials with a crystalline structure B. are polymers containing metal C. are glass–metal composites D. are metallic materials with an amorphous structure
Practical activites within the subject	Not applicable

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