GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Crystallography, PG_00061905						
Field of study	Materials Engineering						
Date of commencement of studies	October 2026		Academic year of realisation of subject		2027/2028		
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	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Maria Gazda				
	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		5.0		40.0	75
Subject objectives	The aim of the course is to familiarize students with the basic concepts of crystallography, such as crystal lattice, unit cell, symmetry, packing density, structural defects, etc., and to link them with the chemical composition and properties of materials. The aim of the course is also to learn and acquire skills in the field of experimental methods of crystallography.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W04] is familiar with selected aspects of the construction and operation of scientific instrumentation used in materials engineering and related fields, as well as the life cycle of such equipment	Knows the structure and operation of scales, optical microscopes and X-ray diffractometers	[SW3] Assessment of knowledge contained in written work and projects
[K6_U01] is able to analyse and solve complex and non-standard scientific and technical problems in materials engineering based on his knowledge, using appropriate analytical, computational, numerical, simulation, or experimental methods	Is able to use methods to develop X-ray diffractometry results and can use various tools to visualize crystal structures.	[SU1] Assessment of task fulfilment
[K6_U02] is able to independently or in cooperation with a team, design and construct simple devices, measuring instruments, or technical systems, using appropriately selected methods, techniques, tools, and materials	is able to operate a scale, an optical microscope and, under supervision, an X-ray diffractometer	[SU4] Assessment of ability to use methods and tools
[K6_W02] has advanced knowledge of physics and chemistry, including facts, concepts, methods, and theories that enable the description and explanation of complex mechanical and physical phenomena as well as chemical processes; understands their key role in the advancement of civilization	Has knowledge of physics and chemistry enabling simple crystallographic calculations	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Lecture: Introduction: the subject of crystallography, history, crystalline and amorphous materials;Description of three-dimensional spatial networks, Bravais network and atomic basis. Crystallographic axes. Symbols for positions, directions and planes. Crystallographic patterns. Crystal symmetry (closed and open operations). Symmetry groups. Examples of real crystal structures. Their characteristic features and some properties (packing density, coordination number, coordination polyhedron).Inverse network: definition, physical interpretation. Methods of examining the structure of crystals. X-ray diffractometry.Structure defects, types and their impact on the properties of crystalline bodies.How crystals are formed: crystallization, crystal morphology.Physical properties of crystals: density, anisotropy properties, e.g. optical birefringence. **Lab:** The laboratory includes exercises: producing crystals from solution; building 3- and 2-dimensional models of periodic structures; symmetry study; determining packing density; density measurement; tests using an X-ray diffractometer; examination of two-dimensional structures using optical diffraction methods; testing of optically anisotropic materials.

Prerequisites and co-requisites

none

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written test	55.0%	70.0%
Lab assesement	55.0%	30.0%

Recommended reading

Basic literature	Krystalografia, Z. Bojarski i in.
Supplementary literature	any textbook on crystallography or solid state physics
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Consider the two-dimensional structure shown in Figure 1. (a) Select the nodes of the Bravais network. (b) Determine the primitive cell and the atomic basis according to your choice.2. The unit cell (cube) of a certain intermetallic compound is shown in the figure below. Name this structure and determine the summary formula of the compound.3. Draw the (314), (010) and (111) planes in a crystal with an orthorhombic structure with lattice constants a = 4 Å, b = 6 Å and c = 8 Å. Write the indicators of the directions in which the closest atoms meet.4. Define the packing density and calculate it (find the expression, without numerical calculations) for the regular structure shown in the figure (the one for question 1), if it is known that the radius of Au is equal to 1.1 of the radius of Cu.5. State and explain the Bragg/Laue condition6. What defects in the crystal structure have the greatest impact on:a) mechanical properties of metals?b) color of ionic crystals?What is the impact? Justify your answers briefly.7. What is crystal anisotropy?

Practical activites within the subject

Not applicable

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