COURSE DESCRIPTION CARD - SYLLABUS

Course name
Crystallography [S1IFar1>Krys]

Course

Field of study
Pharmaceutical Engineering

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
12

Laboratory classes
18

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basics of general and physical chemistry

Course objective

providing knowledge on: - basic crystallographic laws and concepts - molecular and crystal symmetry - the structure of ideal and real crystals, methods describing crystal structures and classification of crystalline material - relationships between the structure and the physical and chemical properties of crystals skill development: - use of crystallographic terms - use of the Hermann-Maugin and Schoenflies notation to determine the symmetry of molecules and crystals - classification and explanation of crystal structure based on the densest packing of equal spheres - use of crystallographic scientific literature, International Tables for Crystallography and other available sources

Course-related learning outcomes

Knowledge:
e-w1. has ordered general knowledge about the structure of crystals and crystal engineering
e-w3. has knowledge of the three-dimensional structure of molecules and crystals that allows understanding and description of physical phenomena and processes occurring in crystals

e-w4. has knowledge of the basic conceptual categories and terminology used in crystallography
e-w5. has knowledge of the development and research methods used in crystallography
e-w6. understands the relationship between the achievements of crystallography and natural and medical sciences, and the possibilities of their use in socio-economic life

Skills:
e-u1. is able to obtain information from literature, databases and other properly selected sources, also in english. is able to integrate and interpret the information obtained, as well as draw conclusions and formulate and substantiate opinions
e-u2. based on general and crystallographic knowledge explains the structure of chemical compounds and is able to relate the crystal structure with its properties
e-u3. uses correct terminology related to crystal lattice and symmetry
e-u4. uses computer programs supporting the implementation of tasks typical of explaining the symmetry of molecules and crystals and analyzing the structure of molecules
e-u6. can work both individually and in a team

Social competences:
e-k1. is ready to critically assess his knowledge, understands the need for further education, supplementing disciplinary knowledge and raising his professional competences, understands the importance of knowledge in problem solving and is ready to seek expert opinions
e-k2. can interact and work in a group

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
1. Verification of knowledge, assessment of the student"s ability to work independently
2. Observation of student work, assessment of the ability to perform assigned tasks
3. Observation of student work, assessment of student behavior in individual and group work
4. Course assessment criteria:
- presence required by study regulations
- performance of tasks
- report compilation
- obtaining credits from two partial tests
- passing the final exam

In case of cancellation of classroom lectures due to an epidemic, classes and exams will be held remotely on Teams and sOLAT platforms.
5. Assessment criteria

Both tests are conducted in writing. The assessment threshold is 60% for tests carried out in a classroom and 70% for tests carried out remotely.
The final exam is conducted in writing (open and closed questions) and covers the issues from lectures and classes. The assessment threshold is 60% for the exam held in a classroom and 70% for the exam conducted remotely.

Programme content

Lectures:
The development of crystallography as a science; basic definitions, laws and concepts: crystal lattice, the unit cell, Bravais lattices, crystallographic systems, latice points, directions and planes as well as their indexing; symmetry in crystal morphology - point groups: symmetry with respect to point, direction and a plane, inverse axes and combinations of symmetry elements; symmetry in the structure of crystals - space groups: translation, Bravais cells, screw axes and glide planes, symmetrically equivalent points; matrix symmetry elements; classification of crystal structures based on chemical bonds, chemical composition and stoichiometric relations: coordination number, coordination polyhedron, atomic and ionic radii, close packing of equal spheres, crystal structures of elements and simple chemical compounds; physical and chemical transformations taking place in crystals: defects, solid solutions; phase transformation, polymorphism and isomorphism, inclusion compounds, quasicrystals; crystal engineering: structure and properties of materials, design of new materials.
Laboratory:
Determination, description and classification of molecules and crystals due to symmetry. Symmetry of

molecules, crystal symmetry, translational symmetry. Point groups and crystallographic systems. Symmetrical transformations. Hermann-Maugin and Schoenflies symbols. Bravais cells. Structures of elementsand simple chemical compounds. Structures with the most dense space filling. Coordination numbers and coordination polyhedrons. Conformation, types of hybridization, types of strong and weak intermolecular interactions, configuration and chirality, polymorphism, International Crystallographic Tables, literature.

Teaching methods

1. Lecture using audiovisual equipment with a discussion explaining any doubts related to the knowledge being transferred.
2. Laboratories based on the student''s independent work with the use of teaching aids that facilitate the development of spatial intelligence and understanding of issues related to symmetry and the construction of crystals. Activating teaching methods.

Bibliography

Basic
1. Z. Bojarski, M. Gigla, K. Stróż, M. Surowiec, Krystalografia. Podręcznik wspomagany komputero, Wydawnictwo Naukowe PWN, Warszawa 2007 (oraz wydania wcześniejsze),
2. Z. Kosturkiewicz, Metody krystalografii, Wydawnictwo Naukowe UAM, Poznań 2004.
3. M. Blicharski, Wstęp do inżynierii materiałowej, Wydawnictwo Naukowo-Techniczne, Warszawa 2001.
Additional
1. Z. Trzaska-Durski i H. Trzaska-Durska „Podstawy krystalografii”, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2003.
2. International Tables For Crystallography; Vol. A, Space-Group Symmetry, Vol. B, Reciprocal Space, Vol. C, Mathematical, Physical and Chemical Tables, Volume D: Physical properties of crystals, London, 1996, 2010.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	39	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	11	0,50