COURSE DESCRIPTION CARD - SYLLABUS

Course name
Solid State Chemistry

Course

Field of study
Pharmaceutical Engineering
Area of study (specialization)
-
Level of study
First-cycle studies
Form of study
full-time

Year/Semester
2/3
Profile of study
general academic
Course offered in
polish
Requirements
compulsory

Number of hours

Lecture
15
Laboratory classes
0
Other (e.g. online)
0
Tutorials
15
Projects/seminars
0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
PhD Eng. Aleksandra Grząbka-Zasadzińska

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Responsible for the course/lecturer:
dr hab. inż. Dominik Paukszta

Prerequisites

The student should have knowledge of the basics of inorganic and organic chemistry, mathematics and physics. Has the necessary knowledge about raw materials and products used in chemical technology and engineering. The student should be able to obtain information from literature, databases and other properly selected sources

Course objective

Obtaining knowledge in the field of solid structure, condensed phase reactions and phase transitions occurring in it, and learning methods of morphological and diffractometric solids research.

Understanding the relationship between the structural structure of a solid and its properties. Understanding the importance of solid phase in the pharmaceutical industry.

Course-related learning outcomes

Knowledge

1. The student has general knowledge about solid state reactions in various phase systems - [K_W1]

2. Student has knowledge of physics to the extent that he can describe phase transitions

and polymorphs in condensed phase - [K_W3]

3. The student has ordered, theoretically founded general knowledge to the extent that allows the description of diffusion processes and solid state reactions - [K_W4]

4. Student has knowledge of the methods of characterizing solids, in particular morphology and supermolecular structure - [K_W7]

Skills

1. The student has the skills to obtain information from literature and databases enabling the determination of solids structure using modern research techniques - [K_U1]

2. Student has knowledge related to the use of X-ray diffraction in identification tests of solids - [K_U11]

3. Student has the skills to plan and carry out selected reactions in the solid phase and to describe physicochemical phenomena during their course (diffusion, phase transitions) - [K_U12]

Social competences

1. The student understands the need for further training and raising their professional competences - [K_K1]

2. Student is able to work in a group and is ready to lead a team - [K_K2]

3. The student is aware of the importance of the effects of engineering activities, including environmental impact - [K_K3]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: Stationary classes- the knowledge acquired during the lecture is verified in the form of a written exam at the end of the lecture cycle. The exam consists of 10-20 test questions and 5-10 open-ended questions. Exam issues will be sent to students by e-mail using the university's e-mail system. If it won't be possible to conduct the exam in the stationary form, the state of knowledge will be verified in the form of an on-line test (10-20 closed questions and 5-10 open questions) using the eKursy platform. Passing threshold: 50% of points.

Tutorials: Skills acquired during the tutorials are verified on the basis of the final test, consisting of 3-5 open tasks. If it won't be possible to conduct the test in the stationary form, the state of knowledge will be verified in the form of an on-line test (5-10 closed questions and up to 5 open questions) using the eKursy platform. Passing threshold: 50% of points.

Programme content

1. The essence of solid state. Classifications of solids. Metals. Ceramic materials. Polymer materials.

2. Solid phase reactions, mechanism of reaction between solids, reactions in single and multiphase systems, reactions occurring at phase boundaries, double exchange reactions, topochemical reactions, thermal solids decomposition, phase distribution kinetics, sintering and grain growth.

3. Phase equilibria in solids, I and II order phase transitions, systems of two substances showing unlimited or limited solubility in solid state - solid solutions. Solid surface - the structural and chemical nature of surfaces and surface layers in solids.

4. Condensed phase diffusion, description of the diffusion process, lattice, surface and grain boundary diffusion, reaction diffusion, diffusion and ionic conductivity, Kirkendall-Frenkel effect, chemical diffusion coefficient, diffusion controlled reactions.

5. Phenomenological description of the crystallization process, stages of the crystallization process: nucleation and crystallization, homogeneous and heterogeneous nucleation, thermal and athermal nucleation, row nucleation: shish-kebab structure, surface and volumetric energy of the nuclei, free energy of the nucleation process, interfacial energy, critical radius of the nuclei , energy vs. nuclei radius, nucleation rate and nucleation density, crystal growth, kinetics of the isothermal and nonisothermal crystallization process. Polymorphism. Adhesion in solids. Crystallization processes of both single crystals and macromolecular systems.

6. Structure and properties of metals, fibrous structures: mineral, lignocellulosic and synthetic. Molecular and supermolecular structure of fibers. Orientation and texture of solids. The relationship between the structure and properties of the condensed phase.

7. X-ray diffraction on the crystal structure, Bragg and Laue diffraction conditions. Structural tests using a horizontal and four-wheel diffractometer. Identification and quantitative analysis by X-ray diffraction in wide angles, application of the PDF-4 database in identification analysis. Studies of morphology and topography of solid surfaces by microscopic techniques.

Teaching methods

1. Lecture: multimedia presentation, illustrated with examples given on the board.

2. Tutorials: multimedia presentation illustrated with examples given on a blackboard, teamwork.

Bibliography

Basic

1. J .Dereń, J. Haber, R .Pampuch, Chemia ciała stałego, PWN,1975.

2. Ch. A. Wert, R. M. Thomson, Fizyka ciała stałego, PWN 1974.

3. W. Przygocki, A Włochowicz, Uporządkowanie makrocząsteczek w polimerach i włóknach, WNT 2006.

Additional

1. Von Meerssche, J.Feneau-Dupont, Krystalografia i chemia strukturalna, PWN, 1984.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	40	1,6
Student's own work (preparation for test and exam) [1]	35	1,4

[1] delete or add other activities as appropriate