SYLLABUS
summer semester 2026/2027

Lecturer: dr hab. Maria Augustyniak-Jabłokow, prof. IFM PAN
dr inż. Roman Strzelczyk
dr inż. Przemysław Skokowski

Lecture title	**Introduction to crystallography with elements of structural X-ray diffraction**
Venue	Institute of Molecular Physics Polish Academy of Sciences (IMPPAS)
Language	English
Learning objectives	Ph.D. student: 1. Gains knowledge of the crystal structure of materials, its description, and its classification. 2. Learns methods enabling the study of crystal structure. 3. Will understand the physical principles of X-ray diffraction. 4. Gains knowledge of the hardware setup of X-ray diffractometers, identifying key components and their impact on measurement results. 5. Learns sample preparation techniques and configurations of scan parameters for specific measurements. 6. Learns to analyze experimental results using dedicated software and to interpret phase and profile parameters. 7. Acquires knowledge regarding the determination of crystal structure. 8. Learn the principles of safe work with X-rays. 9. Learns the relationship between the structure and properties of materials. 10. Becomes familiar with various crystal growth methods.
Learning outcomes, according to Attachment 2 to the Programme of the Study (valid from October 1st, 2026)	P8S_WG (pkt.1, 2, and 4), P8S_UW (pkt. 1 i 2), P8S_UK (pkt.3), P8S_KK (pkt.1), P8S_UU / P8_UO (pkt. 1., 2), P8S_KR (pkt.1)
Type of the course	obligatory lecture
Term/Year	summer semesters 2026/2027
Lecturer's and names	dr hab. Maria Augustyniak-Jabłokow, prof. IFM PAN dr inż. Roman Strzelczyk dr inż. Przemysław Skokowski
Name of the examiner	dr hab. Maria Augustyniak-Jabłokow, prof. IFM PAN
Attendance requirements	Working knowledge of English language and physics and solid-state physics at the university level
Number of ECTS points	4 ECTS per academic year
Number of lectures	10+5 practical sessions
Balance of ECTS points	Four (4) ECTS credit
Didactic methods	Lectures with audiovisual techniques Practical sessions Preparing reports on laboratory classes
Methods of verification and assessment of learning outcomes	Written and oral exam. Preparation of laboratory reports.
Conditions of a positive evaluation	A passing grade of the exam. Active participation in laboratory sessions. Preparation of laboratory reports.
Course content	1. Crystal symmetry (crystal systems, unit cell, symmetry classes, Bravais lattices, simple space groups, internal symmetry elements, space groups. International Tables for Crystallography) 2. Basic crystal structure analysis (fundamental laws of crystallography, optical goniometer, stereographic projection). +2 practical sessions. 3. X-rays (methods of generation, interaction with matter, diffraction). 4. Diffraction methods (Laue diffraction pattern, monochromatic methods, two-dimensional X-ray detector, electron diffraction, neutron diffraction). 5. Determination of crystal structure (reciprocal lattice, factors determining the intensity of the diffraction reflection, The structure determination by single-crystal X-ray diffraction) 6. Construction and operation of a powder X-ray diffractometer. +1 practical session.

	7. X-ray diffraction on a polycrystalline sample. +2 practical sessions. 8. Methods of crystal growth. 9. Relationship between structure and material properties. 10. 2D crystals, nanomaterials, and quasicrystals.
Literature constituting the course materials	1. Z. Bojarski, M. Gigla, K. Stróż, M. Surowiec, *Krystalografia*, (Wydawnictwo Naukowe PWN, Warszawa 2007) 2. J. Chojnacki, *Wstęp do Krystalografii* (Wydawnictwo Naukowe PWN, Warszawa 2025) 3. Z. Trzaska Durski, H. Trzaska Durska, *Podstawy krystalografii strukturalnej i rentgenowskiej*, (Wydawnictwo Naukowe PWN, Warszawa 1994) 4. Z. Kosturkiewicz, *Metody krystalografii* (Wydawnictwo naukowe UAM, Poznań 2000) 5. B.D. Cullity, S.R. Stock, *Elements of X-Ray Diffraction*, (Pearson Education Limited 2014) 6. A. Kelly, K.M. Knowles, *Crystallography and Crystal Defects* (Wiley 2012) 7. M. De Graef, M. E. McHenry, *Structure of Materials: An Introduction to Crystallography, Diffraction and Symmetry*, (Cambridge University Press 2007) 8. H.L. Bhat, Introduction to Crystal Growth. Principles and Practice, (Taylor & Francis Group LLC 2015) 9. Lecture hand-outs.