GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Structure Analysis of Solids (C004508)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings in academic year 2026-2027

A (semester 2)	English	Gent

Lecturers in academic year 2026-2027

Dendooven, Jolien	WE04	lecturer-in-charge
Boone, Matthieu	WE05	co-lecturer
Vrielinck, Henk	WE04	co-lecturer

Offered in the following programmes in 2026-2027	**crdts**	**offering**
Master of Science in Physics and Astronomy	6	A
Exchange Programme in Physics and Astronomy (Master's Level)	6	A

Teaching languages

English

Keywords

Solid state, structure, surfaces, microscopy, analytical techniques, characterization, defects

Position of the course

The goal of the course is to make the students acquainted with modern techniques for structural analysis of solid materials. This includes the theoretical background of the different techniques as well as the data analysis and the practical use.
The course is a direct continuation of the courses Materials Physics and Solid State Physics. It is also directly related to almost any dissertation in experimental solid state physics and X-ray imaging.

Contents

• X-ray diffraction for structure determination of crystalline materials: fundamentals, practical use, indexing, phase identification, and pole figure measurements for texture analysis
• Total scattering of X-rays and analysis of the pair distribution function (PDF) for nanostructured and amorphous materials
• Small angle scattering (SAXS) for obtaining structure information on the nanoscale
• EXAFS (Extended X-ray absorption fine structure) for determining the local structure of an atom in crystalline as well as amorphous materials
• Computed Tomography with a focus on high-resolution X-ray CT: data acquisition, reconstruction, visualization and analysis of 3D volumes, and applications
• EPR (Electron paramagnetic resonance) and ENDOR (Electron nuclear double resonance) for the study of defects using magnetic resonance
• Seminars on selected modern techniques for structural analysis: student seminar on a selected topic

Initial competences

Having successfully followed the courses Materials Physics, Solid State Physics, Quantum Mechanics and Atomic and Molecular Physics, or having gained similar expertise by following other courses.

Final competences

1 Apply advanced knowledge of methods, techniques, processes and applications in materials research to analyze and solve complex problems.
2 Analyze, evaluate and structurally synthesize information from scientific literature on experimental solid state physics and materials characterization techniques.
3 Show a professional attitude which is a sign of openness to new scientific developments and their applications in a broad scientific or societal context.
4 Present own literature review appropriately orally to peers.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Practical, Independent work, Peer teaching

Extra information on the teaching methods

• The seminars allow to apply and better understand the concepts introduced in the lectures.
• The practicals (lab sessions) provide an opportunity to apply some theoretical concepts in practice, and gain hands-on experience with some of the characterisation techniques discussed.
• Through independent work, the students immerse themselves in a topic of their own choosing, after which they prepare and give a presentation on it directed to peers.

Study material

Type: Slides

Name: Slides
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

Type: Other

Name: Scientific articles and book chapters
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

References

Takeshi Egami, Simon J.L. Billinge, Underneath the Bragg peaks : structural analysis of complex materials, Pergamon, 2012. ISBN:9780080971339
V. K. Pecharsky, P. Y. Zavalij, Fundamentals of powder diffraction and structural characterization of materials, Kluwer Academic, Boston (2003)
C.R. Brundle, C.A. Evans, S. Wilson, Encyclopedia of Materials Characterization, Butterworth-Heinemann, Boston (1992)

Course content-related study coaching

Individual explanations by instructors, by appointment.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions, Written assessment open-book

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions, Written assessment open-book

Examination methods in case of permanent assessment

Oral assessment, Presentation

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

Continuous assessment: oral presentation in public with question round.
End-of-term assessment: written exam, partly closed-book, partly open-book.

Calculation of the examination mark

Continuous assessment (30%) + End-of-term assessment (70%)