

Course Specifications

From the academic year 2017-2018 up to and including the

Micro-analysis and Structure Determination in Materials Science (E065340)

Course size (nominal values; actual values may depend on programme)
Credits 6.0 Study time 180 h Contact hrs 60.0 h

Course offerings and teaching methods in academic year 2018-2019

Offering	Language	Teaching Methods	Hours
A (semester 1)	English	practicum	30.0 h
		lecture	30.0 h
C (semester 1)	Dutch	guided self-study	30.0 h
		practicum	30.0 h

Lecturers in academic year 2018-2019

Petrov, Roumen TW08 lecturer-in-charge

Offered in the following programmes in 2018-2019

Programme	crdts	offering
Bridging Programme Master of Science in Sustainable Materials Engineering	6	A
Bridging Programme Master of Science in Materials Engineering	6	C
Master of Science in Electromechanical Engineering (main subject Control Engineering and Automation)	6	A
Master of Science in Electromechanical Engineering (main subject Electrical Power Engineering)	6	A
Master of Science in Electromechanical Engineering (main subject Maritime Engineering)	6	A
Master of Science in Electromechanical Engineering (main subject Mechanical Construction)	6	A
Master of Science in Electromechanical Engineering (main subject Mechanical Energy Engineering)	6	A
Master of Science in Chemical Engineering	6	A
European Master of Science in Nuclear Fusion and Engineering Physics	6	A
European Master of Science in Nuclear Fusion and Engineering Physics	6	A
Master of Science in Sustainable Materials Engineering	6	A
Master of Science in Materials Engineering	6	C
Master of Science in Engineering Physics	6	A
Master of Science in Chemical Engineering	6	A
Master of Science in Engineering Physics	6	C

Teaching languages

Dutch, English

Keywords

LOM, SEM, TEM, X-ray diffraction, EBSD, AFM.

Position of the course

The course aims to give the student an insight in the techniques for the micro-analysis and structural analysis of modern engineering materials. Both theoretical principles and practical applications together with the specific sample preparations techniques are given an in-depth review. Fundamentals of particle beams, beam-sample interactions and beam optics are discussed. The architecture of specific equipment is discussed in detail.

Contents

- Chapter 1: Fundamentals of Materials Analysis. Basic principles of microstructure characterization. Sample preparation.
- Chapter 2: Optical microscopy. Quantitative materialography.
- Chapter 3: Interactions of radiations with the matter. Resolution of the different imaging systems.
- Chapter 4: Electron Microscopy Fundamentals. SEM-EDX -WDS.
- Chapter 5: Fundamentals of applied crystallography. Texture introduction. Orientation mapping with EBSD.
- Chapter 6: XRD Structural Analysis of Solids. Introduction to X-ray diffraction. Generation of x-rays, interactions, architecture of diffractometer, basic methods for phase analysis, lattice parameters, stress and strain, texture measurements.
- Chapter 7: Transmission Electron Microscopy (TEM)
- Chapter 8: Atomic force microscopy, (AFM), Atom probe microscopy.
- Chapter 9: Advanced and non-conventional methods for materials characterization: High temperature measurements, 3D-microstructural characterization (OM, SEM, EBSD, XRD-synchrotron and tomography).

Initial competences

Introductory chemistry and physics

Final competences

- 1 Understanding principles and methods for sample preparation.
- 2 Understanding the operational principles of optical microscopy, scanning and transmission electron microscopy, X-ray diffraction, electron backscatter diffraction, atom probe tomography and others.
- 3 Understanding and applying the principles of compositional and microstructural analyses of materials.
- 4 Practical skill to use the studied methods and to analyse the results independently.

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

Guided self-study, lecture, practicum

Extra information on the teaching methods

Lectures, practicum

Learning materials and price

- P.E.J. Flewitt and R.K. Wild, Physical Methods for Materials Characterization, Second Edition, Institutes of Physics Publishing Bristol and Philadelphia, Ltd 2003, ISBN 0 7503 0808 7.
- Copy of presentations for each lecture and selected chapters of books are provided to the students via Minerva

References

- Basic:
 1. P.E.J. Flewitt and R.K. Wild, Physical Methods for Materials Characterization, Second Edition, Institutes of Physics Publishing Bristol and Philadelphia, Ltd 2003, ISBN 0 7503 0808 7.
 2. Copy of presentations from each lecture.
- Additionally recommended:
 3. David B. Williams and C. Barry Carter, Transmission Electron Microscopy, vol.I-IV. Plenum press, New York and London(1996), ISBN 0-306 45247_2.
 4. Valery Randle and Olaf Engler, Introduction to Texture Analysis: Microtexture, Microtexture and Orientation Mapping, Overseas Publishers Association, NY (2000), ISBN: 90-5699-224-4.
 5. B. Cullity, Elements of X-ray diffraction (second edition), Addison Wesley publishing company INC. ISBN: 0-201-01174-3.
 6. L. Reimer, Scanning Electron Microscopy: Physics of Image Formation and Microanalysis, Second Edition, (2000) Meas. Sci. Technol. 11 1826.
 7. Invitation to SEM world Ed. Jeol, Ltd, <http://www.jeol.co.jp>
 8. Bob Hafner, Introductory Transmission Electron Microscopy Primer, Characterization Facility, University of Minnesota—Twin Cities 8/20/2008.
 9. "Materiaalkundige Observatietechnieken" Lecture notes of Prof. B.C.De Cooman Vakgroep Metallurgie en Materiaalkunde, Universiteit Gent, version 2004/2005. Chapters 1, 2, 3, 4

Course content-related study coaching

Evaluation methods

end-of-term evaluation and continuous assessment

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

Written examination

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

Written examination, oral examination

Examination methods in case of permanent evaluation

Skills test

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

- During examination period: written closed-book exam.
- During semester: graded lab sessions.
- Second examination period: Oral exam after written closed book preparation. Supporting materials for solution of the problems will be provided.

Calculation of the examination mark