UNIWERSYTET IM. ADAMA MICKIEWICZA W POZNANIU

# Electron microscopy

Educational subject description sheet

## Basic information

**Study programme**
Fizyka (Physics of Advanced Materials for Energy Processing)

**Speciality**
-

**Organizational unit**
Faculty of Physics

**Study level**
Second-cycle programme

**Study form**
Full-time

**Education profile**
General academic

**Didactic cycle**
2023/24

**Subject code**
04FENS.24S.03269.23

**Lecture languages**
English

**Course type**
Elective

**Block**
specialty subjects

| | |
|---|---|
| **Subject coordinator** | Grzegorz Nowaczyk |
| **Lecturer** | Grzegorz Nowaczyk |

| **Period** | **Activities and hours** | **Number of ECTS points** |
|---|---|---|
| Semester 3 | • Laboratories: 15, Graded credit | 2 |

## Goals

| Code | Goal |
|---|---|
| C1 | to present theoretical background of electron microscopy including basic aspects of electron beam nature, interaction of electrons with matter, electron microscope’s onstruction, types of information that can be provided with electron microscopy, etc. |
| C2 | to conduct experiment by means of EM microscopes including observation of morphologyof solid-state samples, diffraction experiments, elemental analysis by EDS spectroscopy |
| C3 | to interpret acquired data in quantitative and qualitative terms |

## Subject learning outcomes

| Code | Outcomes in terms of | Learning outcomes | Examination methods |
|---|---|---|---|
| **Knowledge – Student:** | | | |
| W1 | a student will be able to explain the theoretical aspects of electron beam | FEN_K2_W01, FEN_K2_W02, FEN_K2_W03, FEN_K2_W04, FEN_K2_W05 | Report |
| W2 | a student will be able to explain types of interaction of electrons with matter | FEN_K2_W01, FEN_K2_W02, FEN_K2_W03, FEN_K2_W04, FEN_K2_W05 | Report |
| W3 | a student will be able to describe construction and function of particular parts of electron microscopes | FEN_K2_W01, FEN_K2_W02, FEN_K2_W03, FEN_K2_W04, FEN_K2_W05 | Report |
| **Skills – Student:** | | | |
| U1 | a student will be able to conduct simple experiment of imaging and diffraction | FEN_K2_U01, FEN_K2_U02, FEN_K2_U03, FEN_K2_U04, FEN_K2_U05 | Report |

## Study content

| No. | Course content | Subject learning outcomes | Activities |
|---|---|---|---|
| 1. | Generating electron beam, microscope alignment | W1, W3 | Laboratories |
| 2. | Sample preparation using various techniques | W2, W3, U1 | Laboratories |
| 3. | Image acquisition and processing | W1, W2, W3, U1 | Laboratories |
| 4. | Analysis of data using dedicated software | U1 | Laboratories |

## Additional information

| Activities | Teaching and learning methods and activities |
|---|---|
| Laboratories | Discussion, Laboratory method, Research method (scientific inquiry), Demonstration and observation, Work in groups |

| Activities | Credit conditions |
|---|---|
| Laboratories | Reporta based on conducted studies and theoretical introduction |

## Literature

**Obligatory**

1. Williams, David B., Carter, C. Barry, Transmission Electron Microscopy: A Textbook for Materials Science, Springer 2009

## Calculation of ECTS points

| **Activities** | **Activity hours*** |
|---|---|
| Laboratories | 15 |
| Report preparation | 20 |
| Preparation for classes | 5 |
| Reading the indicated literature | 10 |
| | |
| **Student workload** | **Hours**<br>50 |
| **Number of ECTS points** | **ECTS**<br>2 |

* academic hour = 45 minutes

## Efekty uczenia się dla kierunku

| Kod | Treść |
|---|---|
| FEN_K2_U01 | The graduate can use their knowledge to formulate and solve complex and unusual problems in the field of physical sciences; select and apply appropriate methods and tools necessary to solve a given problem (including advanced IT techniques), as well as adapt existing methods and tools or develop completely new ones |
| FEN_K2_U02 | The graduate can find the necessary information in the professional literature, databases and other sources, in particular in scientific journals basic to physics, and perform critical analysis, synthesis and creative interpretation of the collected information |
| FEN_K2_U03 | The graduate can formulate and test hypotheses related to simple research problems in physics (plan and perform observations, experiments, theoretical calculations or computer simulations and critically evaluate and discuss the results obtained) |
| FEN_K2_U04 | The graduate can prepare, for various audiences, oral presentations and written studies presenting specialized topics in the field of physical sciences in a communicative way, as well as debate on such topics |
| FEN_K2_U05 | The graduate can use English in accordance with the requirements set out for level B2+ of the Common European Framework of Reference for Languages, as well as specialist English terminology in the field of physical sciences |
| FEN_K2_W01 | The graduate knows and understands in-depth selected facts, phenomena, concepts and theories specific to physics and complex relationships between them (constituting advanced general knowledge in the field of physical sciences and representing both key and other selected issues in the field of advanced detailed knowledge in this discipline) |
| FEN_K2_W02 | The graduate knows and understands in-depth selected research methods and tools as well as mathematical models used in physics |
| FEN_K2_W03 | The graduate knows and understands in-depth selected computational methods and information technology tools and techniques used to solve complex problems in physics |
| FEN_K2_W04 | The graduate knows and understands main development trends in the discipline of physical sciences |
| FEN_K2_W05 | The graduate knows and understands the role of physical sciences in the context of fundamental dilemmas and challenges of modern civilization |