COURSE DESCRIPTION CARD - SYLLABUS

Course name
Characterization Techniques of Materials

Course

Field of study
Chemical Technology
Area of study (specialization)
Composites and Nanomaterials
Level of study
Second-cycle studies
Form of study
full-time

Year/Semester
I/2
Profile of study
general academic
Course offered in
English
Requirements
compulsory

Number of hours

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

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
Dr. Eng. Paula Ratajczak

Responsible for the course/lecturer:

Prerequisites

The student starting this subject should have a basic knowledge of chemical sciences, nanomaterials and the properties of compounds and elements.

Course objective

To provide students with knowledge on techniques for characterization of compounds, nanomaterials and elements; the method of selecting a specific technique for the type of sample or information to be obtained after the test, detailing the technological progress in the tests carried out

Course-related learning outcomes

Knowledge

• the student knows the basic principles of characterization of materials by physical and chemical methods

• the student knows the basic concepts of the structure of solid, inorganic organic and nanomaterials, their synthesis and methods of their analysis.

• student understands the role of experiment and computer simulation in the design process of engineering issues; is aware of the technical and technological limitations of the apparatus in modeling physical phenomena, technical objects

Skills

• the student is able to use, in not fully predictable conditions, to select and use mathematical methods and models, as well as computer simulations to analyze and evaluate the operation of modeled systems
• the student has the ability to self-study to improve professional competence
• the student is able to develop documentation regarding the implementation of an engineering task and prepare a text containing a discussion of the results of this task

Social competences

• • student understands and appreciates the importance of legal aspects of research and intellectual integrity
• can critically assess knowledge and know its limitations
• can precisely formulate questions to deepen understanding of the topic
• is aware of the importance and understands the non-technical aspects and effects of the engineer's activities, including its impact on the environment and the associated responsibility for the decisions taken

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:
Knowledge acquired as lectures and tutorials is verified by a test, consisting of 5 open questions and 3 calculation tasks, respectively; in both cases the final threshold: 50% of the points. Assessment issues on the basis of which questions are developed are presented to students thematically after each lecture / exercise, and then, sent in full using the university's e-mail system or the eLearning Moodle platform.
Laboratories are classified on the basis of completed laboratory exercises in the groups of 2-3 people and a report summarizing the results and conclusions (one report per group); before starting laboratory classes, the student's basic preparation (oral or written) is verified from the materials provided during organizational classes.

Programme content

I. Structure and properties of materials (crystal structure, bonds in solids, ordering and disorder in matter, thermally activated processes, diagrams and phase transitions, electrons in solids: electrical and thermal properties, optical properties of materials, magnetic properties of materials, mechanical properties materials)

II. Material characterization techniques:

1. Diffraction techniques (X-ray diffraction, low energy electron diffraction, high energy electron diffraction, neutronography.

2. Optical spectroscopy (infrared, visible and ultraviolet spectroscopy, ellipsometry, Raman spectroscopy, luminescence, transmission, absorption, reflection, nonlinear optical spectroscopy)

3. Electron microscopy and spectroscopy (scanning electron microscopy, transmission electron microscopy, photoemission, Auger spectroscopy)

4. Surface microscopy (atomic force microscopy, scanning tunneling microscopy)

5. Methods of material composition analysis (absorption and transmission atomic spectrometry, X-ray fluorescence analysis, mass spectrometry)

Teaching methods

lecture: multimedia presentation, illustrated with examples on the board

tutorials: multimedia presentation, computational tasks performed at the board

laboratories: analysis of samples using research apparatus

Bibliography

Basic

1. 1. P.E.J. Flewitt, R.K. Wild - „Physical Method for Materials Characterisation"

2. Sharma, Surender Kumar (Ed.). – „Handbook of Materials Characterization", Springer, 2018

3. Mauro Sardela (Ed.)– „Practical Materials Characterization", Springer, 2014

4. . Rossington, David R., Condrate, Robert A., Snyder, Robert L – "Advances in Materials Characterization", Springer, 1983 reprint.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	50	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/~~exam, project preparation~~) [1]	25	1,0

[1] delete or add other activities as appropriate