COURSE DESCRIPTION CARD - SYLLABUS

Course name
Advanced SPM Laboratory [S2FT2>ZLMP]

Course

Field of study
Technical Physics

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
0

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

dr inż. Marek Weiss
marek.weiss@put.poznan.pl

dr inż. Marek Nowicki
marek.nowicki@put.poznan.pl

Lecturers

Prerequisites

Basic knowledge of the design and operation of probing microscopes (STM, AFM). Knowledge of materials science and strength of materials and electricity and magnetism.

Course objective

1. Familiarizing students with advanced SPM measurement techniques. 2. Familiarizing students with the nanoindentation technique and the material parameters that can be determined in it. 3. Shaping teamwork skills in students

Course-related learning outcomes

Knowledge:
1. After completing the course, the student understands the principles of operation and physical phenomena used in the individual modes of operation of scanning probe microscopes
2. After completing the course, the student understands the principles of operation and physical

phenomena used in determining the mechanical parameters of materials using the nanoindentation method

Skills:
1. After completing the course, the student is able to select the appropriate measurement mode of the SPM, matching it to the characteristics of the materials they want to examine
2. A student who has passed the course is able to independently operate the SPM in the LFM, FM, MFM, AFM and nanoindenter modes

Social competences:
1. A student who has passed the course is able to plan and carry out measurements using a SPM and a nanoindenter independently and in a team.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

In terms of the methods used to verify the achieved learning outcomes, the following grading thresholds are applied:
50.1-60% - 3.0
60.1-70% - 3.5;
70.1-80% - 4.0;
80.1-90% - 4.5;
from 90.1% - 5.0
The assessment results from the preparation of a laboratory measurement protocol and/or oral response.

Programme content

Participants will learn in a practical way the advanced operating modes of SPM (LFM, FM, MFM, AFM) as well as force spectroscopy and the nanoindentation technique.

Course topics

1. Measurement in MFM (magnetic force microscopy) mode
2. Measurement in FM (force modulation) mode
3. Measurement in CAFM (conductive AFM) mode
4. AFM force spectroscopy measurements
5. Nanoindenter measurement of various materials (metals, semiconductors, polymers)

Teaching methods

Laboratory exercises: practical exercises, conducting experiments, discussion, team work.

Bibliography

Basic:
1. Nan Yao, Zhong Lin Wang, Handbook of Microscopy for Nanotechnology, Springer 2005
2. Ernst Meyer , Roland Bennewitz , Hans J. Hug, Scanning Probe Microscopy: The Lab on a Tip Springer 2021

Additional:
Scientific publications on techniques that are the subject of science

Breakdown of average student's workload

	Hours	ECTS
Total workload	30	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	15	0,50