POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Physics of Metals and Semiconductors [S2FT2>FMiP]

Course

Field of study
Technical Physics

Year/Semester
1/2

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
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Knowledge of experimental physics and expertise in solid state physics. Understanding of quantum mechanics and quantum statistics. Ability to obtain information from indicated sources. Understanding of the need to expand one's competence in knowledge of the basic properties of metals and semiconductors.

Course objective

1. to provide students with specialized knowledge of the theory and experimental methods for the study of metals and semiconductors, with emphasis on understanding the phenomena related to conductivity, optical and magnetic properties of materials. in the classical as well as quantum view. 2. to familiarize students with computational methods in the above-mentioned topics (exercises), in estimation of characteristic parameters of metals and semiconductors at the macro- and nanoscale. 3. to develop in students the ability to analyze the results and publicly present the results and discuss them in the forum.

Course-related learning outcomes

Knowledge:
Student:
1. has an orderly understanding of the physical properties of metals and semiconductors in the

description of classical physics and quantum physics.
2. is familiar with the state of the art regarding the metallic and semiconductor properties of reduced size systems
3. has extensive knowledge of metal and semiconductor applications and relevant nanostructures in modern technologies, in particular nanoelectronics and optoelectronics

Skills:
1. is able, on the basis of the literature, to independently analyze the state of knowledge in the topics of research on selected properties of metals and semiconductors
2. is able to independently estimate which systems of metallic and/or semiconductor materials can be used for applications in the construction of electron devices, sensors of various physical quantities
3. give an oral presentation with well-documented and interpreted results of measurements related to the study of metals and semiconductors
4. give an oral presentation on specific technological applications of semiconductors

Social competences:
1. can independently expand his knowledge on the subject of metals and semiconductors and their applications in innovative technologies and industries
2. can work on the task on his own and in the team, he shows responsibility in this work

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% - satisfactory; 60.1-70% - satisfactory plus; 70.1-80% - good; 80.1-90% - good plus; from 90.1% - very good.
The grade is based on an individual written assignment and/or the assessment of an oral response.

Programme content

The purpose of the course is to present students on the theory and experimental methods for the study of metals and semiconductors, with emphasis on understanding the phenomena associated with electrical conductivity, optical and magnetic properties of these materials. Students will understand the mechanisms of electrical conductivity, based on classical as well as quantum theory (band theory, superconductivity, etc.). Students will acquire knowledge useful in the fields of electronics, photonics and materials engineering.

Course topics

1. Basic properties of metals and semiconductors: electron structure, atomic interactions, characteristics of metals and semiconductors.
2. Electrical conductivity in metals: classical Drudy theory and its limitations, Sommerfeld theory, Fermi - Dirac statistic and its consequences.
3. Band theory: description of electron states in a solid, band structure, occupancy of electron states, Krönig-Penney model.
4. Intrinsic and doped semiconductors: electric charge carriers, effect of temperature on conductivity, overview of semiconductor materials, methods of obtaining semiconductor materials.
5. Junctions in semiconductors: pn junction, Schottky junction, other heterojunctions.
6. Technological applications of semiconductors: diodes, transistors, solar cells, etc.
7. Experimental methods in the properties study of metals and semiconductors.
8. Introduction to superconductivity in metals.
9. Quantum effects in semiconductor devices.

Teaching methods

1. Lecture: multimedia presentations, solving sample tasks on the board,
2. Exercises: solving tasks, discussion.

Bibliography

Basic:

1. Ch. Kittel, Introduction to Solid State Physics, PWN, 1999
2. H. Ibach, H. Lűth, Solid Physics, PWN Scientific Publishing House, 1996
3. I.M. Cydlikowski, Electrons and Semiconductor Holes, PWN, 1976

Additional:
1. S.M. Sze, Physics of Semiconductor Devices, John Wiley & Sons. 2007
2. P.Y. Yu, M. Cardona, Fundamentals of Semiconductors, Springer, 2001
3. N. W. Ashcroft, N. D. Mermin, Solid State Physics, PWN 1986

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	47	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	53	2,00