GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Physics of Materials I, PG_00039806		
Field of study	Materials Engineering, Materials Engineering, Materials Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Solid State Physics -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Barbara Kościelska	
	Teachers	dr inż. Marta Prześniak-Welenc Michał Maciejewski prof. dr hab. inż. Barbara Kościelska	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	0.0	0.0	45

E-learning hours included: 0.0

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	5.0	50.0	100

Subject objectives

The main aim is to give the fundamental knowledge in solid state physics and also the interpretation physical properties of materials

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W03	Basic knowledge of materials science and the ability to connect the internal structure of materials with their response to external conditions.	[SW1] Assessment of factual knowledge
K6_K01	Understanding the need to improve professional and personal competences and, if necessary, the ability to refer to experts.	[SK5] Assessment of ability to solve problems that arise in practice
K6_U01	Ability to select analytical and experimental methods to measure selected properties of materials.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools

<table>
<tr><td>Subject contents</td><td>1. A short introduction to atomic and quantum physics.

2. Crystal binding energy. Bonds: ionic, covalent, metallic, molecular. Crystal structure.

3. Thermal properties of solids. Vibrations of atoms in crystals - phonons. Phonon statistics. Density of states. Specific heat: Dulong-Petit law, Einstein and Debye models. Thermal conductivity of solids. Thermal expansion of solids.

4. Classical theory of free electrons in metal. Electrical conductivity of metals. Quantum models of electrons in a crystal. Density of electronic states. Crystal band structure. Electronic thermal conductivity and specific heat.

5. Semiconductor crystals. Electron statistics - concentration of intrinsic carriers. Fermi level in an intrinsic semiconductor. Conductivity. Doping states. Equation of electrical neutrality of a semiconductor. Fermi level in a doped semiconductor. Ionization energy of the admixture. Conductivity.of doped semiconductors.

6. Examples of semiconductor devices.

7. Glasses and amorphous materials and their preparation. Short-range ordering, transition from liquid phase to glass phase.

8. Dielectrics. Macroscopic and microscopic description of dielectrics. Polarization. Piezoelectrics and ferroelectrics.

9. Magnetic materials. Microscopic and macroscopic description of magnetic materials. Diamagnetism, paramagnetism, ferromagnetism.

10. Superconductivity, properties of the superconducting state, I and II - type of superconductors, Cooper pairs, high temperature superconductors. Josephson phenomena.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Fundamental knowledge in physics and analytical mathematics</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Written exam</td><td>50.0%</td><td>70.0%</td></tr>
<tr><td>Test concerning laboratory exercises</td><td>50.0%</td><td>15.0%</td></tr>
<tr><td>Evaluation of results of laboratory exercises</td><td>50.0%</td><td>15.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. D. Halliday, R. Resnick, J. Walker, Podstawy fizyki t.V, PWN 2003, 2. B.N. Buszmanow, J.A. Chromow, Fizyka Ciała Stałego , Wyd. N-T, 1973 3. Ch. A. Wert, R.M. Thomson, Fizyka CiałaStałego, PWN,1974 4. J. Massalski, Fizyka dla inżynierów Część II Fizyka współczesna, Wyd. N-T, 2009</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Fizyka materiałów - Moodle ID: 32995
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32995</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>Amorphous and crystalline solids. Liquid crystals. Bonding energy in crystals. Types of bonds: Ionically and covalently bonded solids. Metallic and molecular bonding.Thermal properties of solids. Atomic vibrations in crystals. Phonons. Heat capacity, thermal expansion, thermal conductivity of solids. Classical theory of free electrons in metals. Fundamentals of band theory. Quantum model of free electrons in metals. Fermi-Dirac distribution. Density of states. Band theory of electrical conduction in metals. Specific heat capacity of the electrons. Thermal conductivity in metals. Superconductivity. Macroscopic properties of superconductors. Classification of solid in the frame of band theory of solids. Intrinsic and extrinsic semiconductors. Effective mass. The role of doping. Electrical conductivity. Magnetic properties of materials. Lasers</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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