



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 2022	Academic year of realisation of subject			2022/2023		
Education level	second-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	1	Language of instruction			Polish		
Semester of study	1	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	dr hab. inż. Barbara Kościelska					
	Teachers	dr hab. inż. Barbara Kościelska dr hab. inż. Natalia Wójcik					
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						
Additional information:							
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		
	K7_W04	In-depth knowledge of the internal structure of materials and its relationship with their chemical and physical properties.			[SW1] Assessment of factual knowledge		
	K7_U03	The ability to formulate a research hypothesis and to plan and conduct an experiment that will confirm it.			[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject		

Subject contents	<p>1. A short introduction to atomic and quantum physics.</p> <p>2. Crystal binding energy. Bonds: ionic, covalent, metallic, molecular. Crystal structure.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>6. Examples of semiconductor devices.</p> <p>7. Glasses and amorphous materials and their preparation. Short-range ordering, transition from liquid phase to glass phase.</p> <p>8. Dielectrics. Macroscopic and microscopic description of dielectrics. Polarization. Piezoelectrics and ferroelectrics.</p> <p>9. Magnetic materials. Microscopic and macroscopic description of magnetic materials. Diamagnetism, paramagnetism, ferromagnetism.</p> <p>10. Superconductivity, properties of the superconducting state, I and II - type of superconductors, Cooper pairs, high temperature superconductors. Josephson phenomena.</p>														
Prerequisites and co-requisites	Fundamental knowledge in physics and analytical mathematics														
Assessment methods and criteria	<table border="1" data-bbox="448 871 1487 1055"> <thead> <tr> <th data-bbox="448 871 794 902">Subject passing criteria</th> <th data-bbox="794 871 1141 902">Passing threshold</th> <th data-bbox="1141 871 1487 902">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 902 794 958">Test concerning laboratory exercises</td> <td data-bbox="794 902 1141 958">50.0%</td> <td data-bbox="1141 902 1487 958">15.0%</td> </tr> <tr> <td data-bbox="448 958 794 992">Written exam</td> <td data-bbox="794 958 1141 992">50.0%</td> <td data-bbox="1141 958 1487 992">70.0%</td> </tr> <tr> <td data-bbox="448 992 794 1055">Evaluation of results of laboratory exercises</td> <td data-bbox="794 992 1141 1055">50.0%</td> <td data-bbox="1141 992 1487 1055">15.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Test concerning laboratory exercises	50.0%	15.0%	Written exam	50.0%	70.0%	Evaluation of results of laboratory exercises	50.0%	15.0%
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Example issues/ example questions/ tasks being completed	<p>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</p>														
Work placement	Not applicable														