



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		

Subject contents	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.		
Prerequisites and co-requisites	Fundamental knowledge in physics and analytical mathematics		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Written exam	50.0%	70.0%
	Test concerning laboratory exercises	50.0%	15.0%
	Evaluation of results of laboratory exercises	50.0%	15.0%
Recommended reading	Basic literature	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	
	Supplementary literature	No requirements	
	eResources addresses	Adresy na platformie eNauczanie: Fizyka materiałów - Moodle ID: 32995 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32995	
Example issues/ example questions/ tasks being completed	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		
Work placement	Not applicable		