



## Subject card

Subject name and code	Solid state electronics, PG_00048718						
Field of study	Materials Engineering, Materials Engineering, Materials Engineering, Materials Engineering						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2023/2024		
Education level	first-cycle studies	Subject group			Optional subject group 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	4	Language of instruction			Polish		
Semester of study	7	ECTS credits			3.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Zakład fizyki nanomateriałów -> Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Barbara Kościelska					
	Teachers	prof. dr hab. inż. Wojciech Sadowski 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	0.0	0.0	15.0	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		25.0	75
Subject objectives	The aim of the course is to gain knowledge, skills and competences of solid state electronics.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_K01	Ability to solve problems related to the implementation of specific tasks.			[SK5] Assessment of ability to solve problems that arise in practice		
	K6_W08	Knowledge of the development trend of solid state electronics.			[SW1] Assessment of factual knowledge		
	K6_U06	Ability to analyze data and draw conclusions related to solid state electronics.			[SU2] Assessment of ability to analyse information		
	K6_W07	Detailed knowledge on selected issues of solid state electronics.			[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		

Subject contents	<p>1. Introduction.</p> <p>2. Physics and properties of solids - a review</p> <p>2.1. Density of states in 0D, 1D, 2D and 3D materials.</p> <p>2.2. Band structure of solids: free electron, nearly free electron and tight binding model.</p> <p>2.3. Energy bands and carrier concentration in thermal equilibrium.</p> <p>2.4. Electrical and thermal conduction in solids: carrier transport phenomena.</p> <p>2.5. Kinetic phenomena in semiconductors.</p> <p>3. Metal-semiconductor junctions and p-n junctions.</p> <p>4. Diodes: Schottky diode, p-n diode, MIS, MOS, tunneling diode, resonant-tunneling diode.</p> <p>5. Transistors: bipolar, FET, hot-electron HET and THET, single-electron transistor.</p> <p>6. Light emitting diodes and lasers.</p> <p>6.1. Light emitting diodes.</p> <p>6.2. Semiconductor lasers.</p> <p>6.3. Quantum-cascade laser.</p> <p>7. Photodetectors and solar cells.</p> <p>8. Tunnel phenomena in superconductors: Josephson junction.</p> <p>9. Spintronic devices.</p> <p>10. Semiconductor technology.</p> <p>10.1. Crystal growth and epitaxy.</p> <p>10.2. Film formation.</p> <p>10.3. Lithography and etching.</p> <p>10.4. Impurity doping.</p> <p>11. Summary.</p>
Prerequisites and co-requisites	Knowledge of mechanics, electricity and magnetism, basics of nanophysics, quantum mechanics.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Seminar and presence on lessons	50.0%	34.0%
	written exam	50.0%	66.0%
Recommended reading	Basic literature	<p>1. Aldert van der Ziel <i>Podstawy fizyczne elektroniki ciała Stałego</i></p> <p>2. C. Kittel <i>Wstęp do fizyki ciała stałego</i></p>	
	Supplementary literature	<p>1. S.M. Sze <i>Semiconductor Devices, Physics and Technology</i></p> <p>24. O. Manasreh <i>Semiconductor Heterojunctions and Nanostructures</i></p>	
	eResources addresses	<p>Adresy na platformie eNauczanie:  Elektronika ciała stałego i nanoelektronika - Moodle ID: 32996  <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32996">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=32996</a></p>	
Example issues/ example questions/ tasks being completed	<p>Crystalline structure of solids.</p> <p>Models of electrons in crystals.</p> <p>Semiconductors: band structure of semiconductors, carrier concentration; distribution functions.</p> <p>Kkinetic phenomenas in semiconductors.</p> <p>Contact phenomenas.</p> <p>Diodes.</p> <p>Transistors.</p> <p>Lasers.</p> <p>Tunneling processes in superconductors: Josephson junction.</p>		
Work placement	Not applicable		