



Subject card

Subject name and code	Physics of semiconductor devices, PG_00037293						
Field of study	Technical Physics						
Date of commencement of studies	October 2021	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	3	Language of instruction			Polish		
Semester of study	5	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Department of Physics of Electronic Phenomena -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jędrzej Szmytkowski					
	Teachers	dr hab. inż. Jędrzej Szmytkowski					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	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	60		5.0		60.0	125
Subject objectives	The aim of this course is to understand fundamental physics of semiconductors and devices based on semiconductors.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K6_W02	The knowledge allows to analyze selected problems concerned semiconductors and semiconductor devices in real world			[SW1] Assessment of factual knowledge		
	K6_W07	Student knows how semiconductor devices work.			[SW1] Assessment of factual knowledge		
	K6_U01	Student knows how to use literature and databases in semiconductors and semiconductor devices			[SU2] Assessment of ability to analyse information		
Subject contents	Introduction to solid state physics (structure of crystalline solids, types of chemical bonds in solids, phonons, Fermi-Dirac and Bose-Einstein statistics, Fermi level in metals, electrical conduction in metals, band structure of solids, effective mass). Introduction to semiconductors (electronic hole, Fermi level in semiconductors, direct and indirect energy gap, equilibrium concentration, intrinsic and extrinsic semiconductors, donors and acceptors, generation and recombination of charge carriers, Hall effect, p-n junction). Introduction to semiconductor electrodynamics (mobility of carries, drift and diffusion equations, Poisson equation, continuity equation, space charge, dielectric relaxation, ambipolar transport equation, Shockley equation). Semiconductor devices (photoresistor, Hall effect sensor, magnetoresistor, thermistor, varistor, diode, varicap, Zener diode, Esaki diode, Schottky diode, photovoltaic cell, photodiode, LED, semiconductor laser, bipolar junction transistor, field-effect transistor JFET, field-effect transistor MOSFET, thyristor). Injection, termionic and optical effects in semiconductor devices. MOS capacitor, Charge-coupled device (CCD). Integrated circuits. Semiconductor nanostructures and devices based on them.						
Prerequisites and co-requisites	Completed courses in "Electricity and magnetism" and "Introduction to modern physics"						
Assessment methods and criteria	Subject passing criteria	Passing threshold			Percentage of the final grade		
	Exercises	50.0%			40.0%		
	Written exam	50.0%			60.0%		

Recommended reading	Basic literature	<p>1. C. Kittel "Introduction to solid state physics", PWN</p> <p>2. A. van der Ziel "Fundaments of solid state electronics" WNT</p> <p>3. J. Hennel "Introduction to semiconductor elektronics" WNT</p>
	Supplementary literature	A.K. Jonscher "Fundaments of semiconductor devices" WNT
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Fizyka przyrządów półprzewodnikowych - Moodle ID: 33946 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33946</p>
Example issues/ example questions/ tasks being completed	<p>1. Electronic structure of solid states</p> <p>2. Intrinsic and extrinsic semiconductors</p> <p>3. Diode</p> <p>4. Transistor</p> <p>5. Laser diode</p>	
Work placement	Not applicable	