GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Solid state electronics, PG_00048718		
Field of study	Materials Engineering, Materials Engineering, Materials Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2024/2025
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. 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_W07	Detailed knowledge on selected issues of solid state electronics.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
K6_U06	Ability to analyze data and draw conclusions related to solid state electronics.	[SU2] Assessment of ability to analyse information
K6_W08	Knowledge of the development trend of solid state electronics.	[SW1] Assessment of factual knowledge
K6_K01	Ability to solve problems related to the implementation of specific tasks.	[SK5] Assessment of ability to solve problems that arise in practice

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

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><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>66.0%</td></tr>
<tr><td>Seminar and presence on lessons</td><td>50.0%</td><td>34.0%</td></tr>
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<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. Aldert van der Ziel Podstawy fizyczne elektroniki ciała Stałego

2. C. Kittel Wstęp do fizyki ciała stałego</td></tr>
<tr><td>Supplementary literature</td><td>1. S.M. Sze Semiconductor Devices, Physics and Technology

24. O. Manasreh Semiconductor Heterojunctions and Nanostructures</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Crystalline structure of solids.

Models of electrons in crystals.

Semiconductors: band structure of semiconductors, carrier concentration; distribution functions.

Kkinetic phenomenas in semiconductors.

Contact phenomenas.

Diodes.

Transistors.

Lasers.

Tunneling processes in superconductors: Josephson junction.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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