GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Solid state electronics and nanoelectronics, PG_00037001		
Field of study	Nanotechnology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Specialty 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	1	Language of instruction	English
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department Of Solid State Physics -> Faculty Of Applied Physics And Mathematics -> Wydziały Politechniki Gdańskiej		
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	0.0	30

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	30	2.0	18.0	50

Subject objectives

The aim of the course is to acquire knowledge, skills and competence in the field of solid state electronics and nanoelectronics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] has enhanced, theoretically supported, detailed knowledge of selected branches of nanotechnology and, according to the needs, within the scope of related fields of science and technology.	Posessing the detailed knowledge of the selected field of nanotechnology and related scientific disciplines	[SW1] Assessment of factual knowledge
[K7_K09] is aware of the importance and understands non-technical aspects and results of engineering work, including its influence on the environment, and the related responsibility for decisions made.	Understanding non-technical aspects and effects of engineering activities.	[SK2] Assessment of progress of work
[K7_U07] can apply the obtained specialist knowledge to the problems within exact sciences, natural or technical sciences.	Ability to use the obtained knowledge in other fields of science	[SU1] Assessment of task fulfilment
[K7_W03] has general knowledge on current development directions and discoveries in physics, chemistry, technology and applications of nanostructures.	Posessing the knowledge of the newest trends and discoveries in the field of nanostructures	[SW1] Assessment of factual knowledge

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, tunnel 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.
Prerequisites and co-requisites	Completed courses in the field of basics of nanotechnology and solid state physics (or physics of materials).
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
written test	50.0%	100.0%

Recommended reading	Basic literature	1. S.O. Kasap "Principles of electronic materials and devices", McGraw-Hill, 2006, 3rd ed. (El 178223-00-00/01) 2. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, John Wiley & Sons, 2007, 3rd ed. (FM 304796-00-00/01)
	Supplementary literature	1. S.M. Sze, M.K. Lee Semiconductor Devices, Physics and Technology, John Wiley & Sons, 2012, 3rd ed.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	Describe metal-semiconductor junction Describe MOS diode Describe single electron transistor Describe quantum-cascade laser	
Work placement	Not applicable	

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