GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Solid state electronics and nanoelectronics, PG_00037203		
Field of study	Nanotechnology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2026/2027
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	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Solid State Physics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Barbara Kościelska	
	Teachers	prof. dr hab. inż. Barbara Kościelska	

Lesson types

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

eNauczanie source addresses:

Moodle ID: 7468 Elektronika ciała stałego i nanoelektronika
https://enauczanie.pg.edu.pl/2025/course/view.php?id=7468

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	6.0	49.0	100

Subject objectives

The aim of the course is to gain knowledge, skills and competences of solid state electronics and nanoeletronics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_K04	The student is able to work in a group.	[SK1] Assessment of group work skills
K6_W08	The student possesses basic knowledge of solid-state electronics and nanoelectronics.	[SW1] Assessment of factual knowledge
K6_U11	The student is able to prepare presentations and deliver seminars on solid-state electronics and nanoelectronics.	[SU1] Assessment of task fulfilment
K6_W09	The student possesses knowledge regarding the construction and operation of basic electronic devices.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture 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. Course content – seminar 1. 2D semiconductors in electronic applications.

2. LEDs, LED displays, electronic paper.

3. Liquid-crystal and plasma displays.

4. Semiconductor lasers.

5. Photovoltaic cells – latest generations.

6. Photonic crystals and their application in electronics.

7. The Josephson junction and its application in electronics.

8. The Josephson junction as a voltage standard.

9. Low-dielectric-constant materials and their applications. Note: search term is "low-k materials".

10. Infrared detectors and thermal imaging cameras.

11. Scintillation counters.

12. Quantum-well electronic devices.

13. Materials, circuits, and nanomaterials for terahertz (THz) electronics.

14. Electronic devices based on carbon materials.

15. Bioelectronics materials and systems.

Prerequisites and co-requisites

Knowledge od 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 all lessons	50.0%	34.0%
written exam	50.0%	66.0%

Recommended reading

Basic literature	1. Aldert van der Ziel Podstawy fizyczne elektroniki ciała stałego, WNT 1980 2. S.O. Kasap Principles of electronic materials and devices, McGraw-Hill, 2006, 3rd ed. 3. S.M. Sze, M.K. Lee Semiconductor Devices, Physics and Technology,John Wiley & Sons, 2012, 3rd ed. **LUB** S.M. Sze, Kwok K. Ng Physics of Semiconductor Devices, John Wiley & Sons, 2007, 3rd ed.
Supplementary literature	1. C. Kittel Wstęp do fizyki ciała stałego, PWN 2. O. Manasreh Semiconductor Heterojunctions and Nanostructures, McGraw Hill
eResources addresses	

Example issues/ example questions/ tasks being completed	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.
Practical activites within the subject	Not applicable

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