GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Physics of semiconductor devices, PG_00037293		
Field of study	Technical Physics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jędrzej Szmytkowski	
	Teachers		

Lesson types

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_U02] is able to analyse and solve complex and non-standard scientific and technical problems using appropriate analytical, computational, numerical, simulation or experimental methods.	The knowledge allows to analyze selected problems concerned semiconductors and semiconductor devices in real world	[SU3] Assessment of ability to use knowledge gained from the subject
[K6_U01] demonstrates the ability for lifelong independent learning, including acquiring information from literature, databases and other appropriate sources.	Student knows how to use literature and databases in semiconductors and semisonductor devices	[SU2] Assessment of ability to analyse information
[K6_W02] possesses structured knowledge of the fundamentals of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and molecular physics, solid-state physics, and nuclear and particle physics.	Student has a good knowledge about solid state physics.	[SW1] Assessment of factual knowledge

<table>
<tr><td>Subject contents</td><td>Course content – lecture
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). Introduction to semiconductor electrodynamics (mobility of carries, drift and diffusion equations, Poisson equation, continuity equation, space charge, dielectric relaxation, ambipolar transport equation). Semiconductor devices (Hall efect sensor, diode, transistor, LED, diode laser, photoresistor, photovoltaic cell). Injection, termionic and optical effects in devices.
Course content – exercises
Solving exercises which illustrate problems given in the lecture.

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 device</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Completed courses in "Electricity and magnetism" and "Introduction to modern physics"</td></tr>
<tr><td>Assessment methods and criteria</td><td>
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<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Exercises</td><td>50.0%</td><td>40.0%</td></tr>
<tr><td>Written exam</td><td>50.0%</td><td>60.0%</td></tr>
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<tr><td>Recommended reading</td><td>
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<tr><td>Basic literature</td><td>1. C. Kittel "Introduction to solid state physics", PWN

2. A. van der Ziel "Fundaments of solid state electronics" WNT

3. J. Hennel "Introduction to semiconductor elektronics" WNT</td></tr>
<tr><td>Supplementary literature</td><td>A.K. Jonscher "Fundaments of semiconductor devices" WNT</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Electronic structure of solid states

2. Intrinsic and extrinsic semiconductors

3. Diode

4. Transistor

5. Laser diode</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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