GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Basics of molecular electronics, PG_00064049		
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	6	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Division of Molecular Photophysics -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Waldemar Stampor	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	15.0	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	5.0	15.0	50

Subject objectives

To acquaint students with basics of molecular electronics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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.	Understands the optical, electrical and optoelectronic phenomena underlying organic electronic devices	[SW1] Assessment of factual knowledge
[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.	Has an idea of the role of organic materials in some modern fields of technology and in everyday life. Can describe the operation of modern light-emitting diodes, photovoltaic cells and field-effect transistors using appropriate analytical methods.	[SU2] Assessment of ability to analyse information

Subject contents

Course content – lecture
LECTURE: Introduction. Molecular solids Electronic excited states in molecular systems.. Transport of charge carries in molecular solids. Injection-limited currents. The currents of charge carriers of one sign. The currents of charge carriers of two signs. Electroluminescence. Photovoltaic phenomenon. Basic elements of molecular electronics.

Course content – exercises
TUTORIALS: Van der Waals interactions between molecules. Wanier - Mott and Frenkel excitons. Radius and energy of an exciton. Exciton diffusion in a crystal. Schottky effect at a metal/semiconductor junction. Drift and diffusion currents. Childs Law.. Space charge limited (SCL) currents with exponential distribution of traps. Current-voltage curves for SCL currents. Bimolecular recombination. Langevin recombination coefficient.

Prerequisites and co-requisites

Student defines basic terms concernig structure of matter. Student lists basic types of electronics. Student uses basic physical terms.

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Tutorial	50.0%	40.0%
	Oral exam	50.0%	30.0%
	Writen exam	50.0%	30.0%
Recommended reading	Basic literature	1. J. Godlewski, Wstęp do elektroniki molekularnej, Politechnika Gdańska, 2008 2. M. Schwoerer, H.C.Wolf, Organic Molecular Solids, Wiley 2006.	
	Supplementary literature	1. A.Kohler, H.Bassler, Electronic processes in organic semiconductors, Wiley, 2015. 2. S.Forrest, Organic electronics, Oxford University Press, Oxford 2020.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Types of excitons Photophysical processes on the Jabłoński diagram. Space charge limited currents. Child's law. The Langevin mechanism of bimolecular recombination. The principle of operation of organic electronics devices: photovoltaic cell, electroluminescent diode, field effect transistor.		
Practical activites within the subject	Not applicable		

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