



Subject card

Subject name and code	Basics of molecular electronics, PG_00060233						
Field of study	Technical Physics						
Date of commencement of studies	October 2023		Academic year of realisation of subject		2025/2026		
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		3.0		
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		dr hab. inż. Waldemar Stampor				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	0.0	0.0	45
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 46323 Podstawy elektroniki molekularnej FT 2026 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=46323						
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	To acquaint students with basics of molecular electronics.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_U02] Can analyze and solve simple scientific and technical problems, based on possessed knowledge, using analytical, numerical, simulation and experimental methods.		Has an idea of the role of organic materials in some modern fields of technology and in everyday life		[SU2] Assessment of ability to analyse information		
	[K6_W02] Has systematized knowledge of the basics of physics, including mechanics, thermodynamics, electricity and magnetism, optics, atomic and particle physics, solid-state physics, nuclear and elementary particle physics.		Understands the optical, electrical and optoelectronic phenomena underlying organic electronic devices		[SW1] Assessment of factual knowledge		

Subject contents	Course content – lecture LECTURE: Introduction. Properties of molecules. 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: Electric dipole. Electric multipoles. Electric polarizability of atom. Lorentz local field. Clausius Mossotti equation. Orientation polarization. Langevin function. Debyes equation. 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
	Oral exam	50.0%	30.0%
	Tutorial	50.0%	40.0%
	Written 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. J. Kalinowski, Organic Light-Emitting Diodes, Marcel Dekker, New York, 2005. 3. H. Haken, H.C. Wolf, Fizyka molekularna z elementami chemii kwantowej, PWN, W-wa 1998. 4. 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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