



Subject card

Subject name and code	, PG_00037281						
Field of study	Technical Physics						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2022/2023		
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			4.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Zakład Fotofizyki Molekularnej -> Instytut Fizyki i Informatyki Stosowanej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Waldemar Stampor				
	Teachers		dr hab. inż. Waldemar Stampor				
Lesson types and methods of instruction	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						
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		50.0	100
Subject objectives	To acquaint students with basics of molecular electronics.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K6_U02		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		Understands the optical, electrical and optoelectronic phenomena underlying organic electronic devices		[SW1] Assessment of factual knowledge		
Subject contents	<p>LECTURE: Introduction. Properties of molecules. Molecular solids. Electronic excited states in molecular systems. Transport of charge carriers 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.</p> <p>TUTORIALS: Electric dipole. Electric multipoles. Electric polarizability of atom. Lorentz local field. Clausius-Mossotti equation. Orientation polarization. Langevin function. Debye's equation. Van der Waals interactions between molecules. Wannier - 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. Child's Law. Space charge limited (SCL) currents with exponential distribution of traps. Current-voltage curves for SCL currents. Bimolecular recombination. Langevin recombination coefficient.</p>						
Prerequisites and co-requisites	Student defines basic terms concerning 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%		
	Written exam		50.0%		30.0%		

Recommended reading	Basic literature	<p>1. J. Godlewski, Wstęp do elektroniki molekularnej, Politechnika Gdańska, 2008</p> <p>2. M. Schwoerer, H.C.Wolf, Organic Molecular Solids, Wiley 2006.</p>
	Supplementary literature	<p>1. A.Kohler, H.Bassler, Electronic processes in organic semiconductors, Wiley, 2015.</p> <p>2. J. Kalinowski, Organic Light-Emitting Diodes, Marcel Dekker, New York, 2005.</p> <p>3. H. Haken, H.C. Wolf, Fizyka molekularna z elementami chemii kwantowej, PWN, W-wa 1998.</p> <p>4. S.Forrest, Organic electronics, Oxford University Press, Oxford 2020.</p>
	eResources addresses	<p>Adresy na platformie eNauzanie:</p> <p>Podstawy elektroniki molekularnej FT 2023 - Moodle ID: 25589 https://enauzanie.pg.edu.pl/moodle/course/view.php?id=25589</p>
Example issues/ example questions/ tasks being completed	<p>Types of excitons</p> <p>Photophysical processes on the Jabłoński diagram.</p> <p>Space charge limited currents. Child's law.</p> <p>The Langevin mechanism of bimolecular recombination.</p> <p>The principle of operation of organic electronics devices: photovoltaic cell, electroluminescent diode, field effect transistor.</p>	
Work placement	Not applicable	