GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Solar energy conversion, PG_00020840		
Field of study	Technical Physics		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Specialty 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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Molecular Photophysics -> Institute of Physics and Applied Computer Science -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Grygiel	
	Teachers	dr inż. Piotr Grygiel	

Lesson types and methods of instruction

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

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	4.0	26.0	75

Subject objectives

The extension of the students' knowledge about the methods of converting solar energy into other forms of useful energy. Presentation of the theoretical basis of the photovoltaic-, photochemical- and photothermal conversion and current practical solutions using these methods

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U06] can apply obtained knowledge of physics to exact sciences, natural and technical sciences	The student can apply his knowledge of physics to problems from the other natural sciences or engineering.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W02] has enhanced, theoretically-founded, detailed knowledge of selected field of physics, and sufficient knowledge of related fields of science or technology	The student has the relevant theoretical knowledge and specific experience in the conversion of radiant energy into other forms of energy and on the related fields of science and technology	[SW1] Assessment of factual knowledge
[K7_U07] has enhanced skill of preparing speeches in Polish and English, including presentation of own research results	Has an in-depth ability to prepare and deliver an oral presentation on a detailed, including practical, issue of solar energy conversion.	[SU5] Assessment of ability to present the results of task [SU3] Assessment of ability to use knowledge gained from the subject

<table>
<tr><td>Subject contents</td><td>Lecture: Solar radiation - the origin, composition, quantitative description, impact the Earth's atmosphere, the declination of the Sun, the solar time, hour angles, azimuths of sunrise and sunset, the correlation between the sums of solar radiation, solar radiation on a plane inclined to the horizontal, sum of daily radiation. Photovoltaic conversion- theoretical basis, trapping of light in solar cells, solar concentrators, concepts for improving the efficiency of solar cells, the current status and prospects of development of photovoltaic energetics. Photochemical conversion- theoretical basis, methods of using solar radiation to hydrogen production. Photothermal conversion -selective absorber coating of solar panels, transparent cover, antireflection coatings, thermal insulation materials,working fluids with low freezing point, the penetration of solar radiation through the transparent cover collectors , flat liquid collectors, useful thermal power, heat transfer coefficient, heat loss, solar systems for water heating, thermosyphon system , heat storage, water tanks, heat storage using phase transitions.
Seminar :generalized Plancks law, solar radiation, concentration of solar radiation, photoelectrochemical water splitting, photovoltaic hydrogen generation, photovoltaic effect in biological systems, calculating the angle of incidence of the direct component of solar radiation on the surface of the collector, method of calculating the transmissivity of the collector cover , transmission-absorption coefficient, flat liquid collector in the transient state, the parameters of flat plate collectors and their determination, optimal angle of the flat plate collector, solar systems, analysis of the collector battery, air collector Trombe's, the operation of a water tank with water completely mixed and with thermal stratification, the principle of operation, characteristics, problems of design and operation of vacuum collectors.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></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>seminar: paper</td><td>100.0%</td><td>50.0%</td></tr>
<tr><td>lecture : two tests</td><td>50.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. Z.M. Jarzębski, Energia słoneczna, PWN 1990
2. A. Luque , S. Hegedus , Handbook of photovoltaic science and engineering, Wiley 2003.
3. J. Nelson , The physics of solar cells , ICP, 2003
4. W. Smolec, Fototermiczna konwersja energii słonecznej, Wyd. Naukowe PWN, Warszawa 2000.
5. H. Kaiser, Wykorzystanie energii słonecznej, Wydawnictwa AGH, Kraków 1995.</td></tr>
<tr><td>Supplementary literature</td><td>1. P. Wurfel, Physics of Solar Cells, Wiley-VCH, Weinheim, 2005</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Konwersja energii słonecznej - Moodle ID: 45597
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=45597</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Basic structure of photovoltaic cells
2. The concepts leading to increased efficiency of solar cells
3. The methods of storing thermal energy generated by solar radiation</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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