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 2026	Academic year of realisation of subject	2025/2026
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 Classes are conducted in Polish and English; in the case of foreign students, classes are conducted exclusively in English.
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 -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Grygiel	
	Teachers	dr inż. Piotr Grygiel	

Lesson types

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

Consolidating and expanding knowledge of methods and techniques for converting solar radiation energy into other types of useful energy. Presenting the theoretical basis of photovoltaic, photochemical and photothermal conversion, as well as current practical solutions using these methods.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] has enhanced, theoretically-founded, detailed knowledge of selected field of physics, and sufficient knowledge of related fields of science or technology	He has in-depth, theory-based knowledge of the areas of physics used in modern solar energy conversion methods and techniques.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
[K7_U06] can apply obtained knowledge of physics to exact sciences, natural and technical sciences	Can apply acquired knowledge of physics in technical areas used in solar energy conversion processes.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task
[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 presentations in Polish and English on physics and energy conversion techniques, including the use of the results of any own scientific research.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task

<table>
<tr><td>Subject contents</td><td>Course content – 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. The basis of hybrid PVT system operation.

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.

Course content – 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. PVT systems.

It is possible to prepare a presentation on a topic of your choice, after consulting with the course instructor.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>seminar: oral presentation with preparation of a presentation</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>lecture: final examination</td><td>50.0%</td><td>50.0%</td></tr>
</table>
</td></tr>
<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.</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></td></tr>
</table>
</td></tr>
<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>Practical activites within the subject</td><td>Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.