GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Solar Plants, PG_00042163		
Field of study	Power Engineering, Power Engineering, Power Engineering, Power Engineering, Power Engineering		
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 Polish or english
Semester of study	6	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Controlled Electric Drives -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Kołodziejek	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	15.0	0.0	45

E-learning hours included: 0.0

Additional information:
Lectures, laboratory exercises in the Control Systems in the Renewable Energy Sources Laboratory, visiting as guests in industrial organization representatives and implementing scientific research representatives in the field of solar power plants and radiation effects. Photovoltaic module design: AR coatings, textutring, reflectors, lifetime. PV modules modeling, operation issues: shading effect, DC/DC, DC/AC dedicated converters and control system synthesis. Efficiency, characteristics and equivalent circuit model parameter measurement and estimation.Maximum Power Point Tracking algorithms, extremal control strategies, local and global extremum identification.

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

Theory of solar energy conversion. Characteristics of Sunlight and light sources. PN junction basics, materials, conduction, band gap, doping, intristic and equilibrium carrier concentration. Light absorption and electron-hole pair generation and recombination, total current calculation. Solar cells parametrs IV and PV curves, Voc, Isc, efficiency. Resistive, temperature l.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W08	know control system basics, electrical circuit theory, digital signal basics and processing methods.	[SW3] Assessment of knowledge contained in written work and projects
K6_U04	can design, connect and start control system of solar power plant	[SU1] Assessment of task fulfilment
K6_W05	has structured knowledge concerning electrical measurements, their result documenting and measurement error uncertainity determination	[SW3] Assessment of knowledge contained in written work and projects

Subject contents	**Lecture:** Theory of renewable energy conversion with particular emphasis on photovoltaics and wind energy conversion. I. Solar energy conversion. Characteristics of Sunlight and light sources. PN junction basics, materials, conduction, band gap, doping, intristic and equilibrium carrier concentration. Light absorption and electron-hole pair generation and recombination, total current calculation. Solar cells parametrs IV and PV curves, Voc, Isc, efficiency. Resistive, temperature and radiation effects. Photovoltaic module design issues: AR coatings, textutring, reflectors, lifetime. PV modules modeling, operation issues: shading effect, DC/DC, DC/AC dedicated converters and lcontrol system synthesis. Efficiency, characteristics and equivalent circuit model parameter measurement and estimation. Maximum Power Point Tracking algorithms, extremal control strategies, local and global extremum identification, fault tolerant control. **Laboratory:** 1. Modeling and simulation of photovoltaic modules, I-V and P-V characteristics examination including radiation and temerature effects, equivalent circuit parameters calculation, energy generation analysis. 2. Hybrid maximum power point tracking algorithms for the PV shading effect and fault tolerant control. 3. Solartracker control algorithms. Sensorless maximum power point tracking.4 4. Solar energy resources measurement and analysis. 5. Photovoltaic module characteristics measurement and efficeincy analysis and equivalent circuit parameters. 6. DC/DC and DC/AC converter topologies for photovoltaics experimental tests.
Prerequisites and co-requisites	Basics of electrical circuits theory and physics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture test	50.0%	50.0%
Laboratory exercises reports	100.0%	50.0%

Recommended reading

Basic literature	1. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al-HaddHaddHaddad, Power Electronics for Renewable Energy Systems, Wiley 2014. 2. IEEE articles.
Supplementary literature	IEEE articles.
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Characteristics of the photovoltaic module including temperature, radiation, resistive and shading effects. 2. Characteristics, structures of the maximum power point tracking control system algorithms. 3. Maximum power point tracking algorithms for solar power plant control system. 4. Hybrid extremal control systems application in the renewable energy sources. 5. Sensorless and measurement-based solartracker control systems. 6. Fault tolerant control of the solar power plant. 7. Efficiency and quality of the solar power conversion.
Work placement	Field exercises