GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Smart energy networks, PG_00062761		
Field of study	Technologies for Industry 5.0		
Date of commencement of studies	October 2024	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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit			
Name and surname of lecturer (lecturers)	Subject supervisor		
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

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	15	2.0	33.0	50

Subject objectives

The aim of the course is to familiarize students with the concept, architecture and technologies of smart energy networks (Smart Grid). Students will learn about the elements of Smart Grid systems, distributed generation technology, energy storage technologies, methods of monitoring and protecting the network, demand management and cybersecurity

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_K01] is aware of the need to constantly update and enrich knowledge and practical skills, and improve professional, personal and social competences	The student will be aware of the need to constantly update and enrich their knowledge and practical skills. The student will be ready to participate in training and courses to improve their qualifications and work in a team and communicate in an interdisciplinary context.	[SK2] Assessment of progress of work
[K6_W02] demonstrates knowledge and understanding of electronics, automation and telecommunications and systems theory, that enables identification of problems and formulation of solutions appropriate for the fourth and fifth industrial revolutions	The student will understand the key concepts related to smart grids, including electronics, automation, telecommunications, and systems theory. The student will be able to identify problems and formulate appropriate solutions in the context of the fourth and fifth industrial revolutions.	[SW1] Assessment of factual knowledge

Subject contents	Lecture 1 (1h): Introduction to Smart Grid Definition and concept of Smart Grid Main goals and advantages of Smart Grid Examples of Smart Grid applications in the world Future and development of Smart Grid technology Lecture 2 (1h): Smart Grid system architecture Smart Grid structure and components Integration of different technologies in Smart Grid Lecture 3 (1h): Standards for Smart Grid systems Overview of key standards and protocols The role of standards in interoperability and security Lecture 4 (1h): Smart Grid system elements and technologies Key elements of Smart Grid infrastructure Measurement and communication technologies Advanced energy management systems Integration of renewable energy sources Lecture 5 (1h): Distributed generation sources Characteristics and types of distributed generation Advantages and challenges of distributed generation Solar and wind energy technologies Integration with the grid power Lecture 6 (1h): Introduction to energy storage devices The role of energy storage in Smart Grid Basic types of storage devices Lecture 7 (1h): Energy storage technologies and battery management Different types of energy storage technologies: chemical batteries, supercapacitors, mechanical and thermal storage Battery management system (BMS): functions and components, battery life cycle optimization Lecture 8 (1h): Modeling and optimization of energy storage devices Modeling and simulation methods for storage devices Examples of mathematical models Optimal storage sizes and locations: optimization criteria and methods, examples of applications in real systems Lecture 9 (1h): Wide area monitoring systems Monitoring technologies and protocols Application in Smart Grid Implementation examples, benefits and challenges Lecture 10 (1h): Phasor estimation and digital relays for protection Phasor estimation methods Application in monitoring and control Types of digital relays Role in Protection and Automation Lecture 11 (1h): Smart Grid Protection Basic Protection Concepts and Strategies Protection Technologies and Tools Fault Detection and Response Integration of Protection with Monitoring Systems Lecture 12 (1h): Modeling Smart Grid Components Storage Device Modeling Methods and Tools Specifics of DC Modeling Integration with Smart Grid System Lecture 13 (1h): Microgrid Operation and Control Principles of AC and DC Microgrid Operation Operational and Control Strategies AC-DC Hybrid Microgrid Integration and Management Application Examples Lecture 14 (1h): Phasor Measurement Unit Location and Cybersecurity Phasor Measurement Unit Location Criteria and Methods Benefits and Challenges Threats and Challenges in Smart Grid Protection Strategies and Technologies Lecture 15 (1h): Smart Grid Design and Management Smart Grid Design and Planning Process Project Examples Virtual Inertia and Auxiliary Support: Concepts and Applications Demand Side Management in Smart Grid: Demand Management Strategies, Examples and Case Studies
Prerequisites and co-requisites	Knowledge of electronics and electrical engineering
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
test	50.0%	100.0%

Recommended reading	Basic literature	1.Smart power grids by A Keyhani, M Marwali. 2.Computer Relaying for Power Systems by ArunPhadke 3.Microgrids Architecture and control by Nikos Hatziargyriou 4.Renewable Energy Systems by Fang Lin Luo, Hong Ye 5.Voltage-sourced converters in power systems_ modeling, control, and applications by Amirnaser Yazdani, Reza Iravani"
	Supplementary literature	nie dotyczy
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	Topics: What are the main components of a Smart Grid infrastructure?What technologies are used to store energy?What are the benefits of using wide area monitoring systems? Questions: Discuss the differences between AC and DC microgrids.How do standards impact Smart Grid security and interoperability?What are the challenges of integrating renewable energy sources into a Smart Grid?	
Work placement	Not applicable	

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