GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	FACTS in Electric Power System, PG_00044086		
Field of study	Electrical Engineering		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department Of Electrical Power Engineering -> Faculty Of Electrical And Control Engineering -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Robert Kowalak	
	Teachers	dr hab. inż. Robert Kowalak	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	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	30	5.0	15.0	50

Subject objectives

Familiarization with the types and structure of FACTS devices used in power systems. Learning about the features of these devices and their impact on the operation of the power system. Assessment of the impact of these devices on the operation of the power system.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W01	Conducts simulations of the operation of selected FACTS systems in the power system.	[SW3] Assessment of knowledge contained in written work and projects
K7_U02	Participates in the discussion of potential applications of FACTS devices.	[SU3] Assessment of ability to use knowledge gained from the subject
K7_W02	Becomes familiar with the impact of FACTS devices on the power quality of the electric power grid. Performs an assessment of the impact of selected FACTS devices on power system operation.	[SW3] Assessment of knowledge contained in written work and projects
K7_U03	Searches for information on FACTS devices.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

LECTURE: The electric power system and the changes occurring in it. Problems in the control of system operation. The need for new devices to regulate the operation of the system. New objects in the system: sources and loads. The scope of application of power electronics in the electric power system. Power electronic switches of high power and their characteristics. Systematics of power electronic devices encountered in electric power systems: APC, FACTS, APF. FACTS devices and their systematics. Impact of FACTS devices on the power system - regulation of voltages and power flows. Construction and principle of operation - shunt, series and series-shunt devices. The importance of these devices for the power system, the regulatory functions performed. The future of FACTS devices. Hybrid FACTS devices. DC links, structures and principle of operation, impact on power systems.

LABORATORY: Modeling the operation of selected FACTS devices (shunt static compensators, series devices, energy storage). Studying the operation of FACTS devices based on models (SVC, STATCOM, TCSC, BESS). Familiarization with the construction of FACTS devices (SVC, STATCOM, TCPAR).

Prerequisites and co-requisites

Knowledge of the electricity system (structure, regulatory processes, risks, etc.).

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Execution of tasks in the laboratory</td><td>60.0%</td><td>40.0%</td></tr>
<tr><td>Theoretical knowledge of the lecture</td><td>60.0%</td><td>60.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Acha E., Fuerte-Esquivel C. R., Ambriz-Perez H., Angeles-Comacho C.: FACTS Modelling and Simulaton in Power Networks, John Wiley & Sons, LTD, 2004.

Aririllaga J., Smith B.: AC-DC Power System Analysis, London 1998, The Institution of Electrical Engineers.

Sood V. K.: HVDC and FACTS Controllers. Applications of Static Converters in Power Systems. Kluwer Academic Publishers Boston, 2004.

Zajczyk R.: Modele matematyczne systemu elektroenergetycznego do badania elektromechanicznych stanów nieustalonych i procesów regulacyjnych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2003.

Kowalak R.: Kompensatory i ich wpływ na pracę systemu elektroenergetycznego, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2019.</td></tr>
<tr><td>Supplementary literature</td><td>Machowski J.: Regulacja i stabilność systemu elektroenergetycznego, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2007.

Barlik R., Nowak. M.: Technika tyrystorowa. Wydawnictwa Naukowo-Techniczne, wydanie trzecie, Warszawa 1994.

Strzelecki R., Supronowicz H.: Filtracja harmonicznych w sieciach zasilających prądu przemiennego, Wydawnictwo Adam Marszałek, Toruń 1998.</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
UKŁADY FACTS W SYSTEMIE ELEKTROENERGETYCZNYM [ET] [2024/25] - Moodle ID: 39893
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=39893</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1. Replace systems belonging to additional devices to control the operation of the power system - indicate their role in the power system.
2. Types of modern power electronic systems supporting the work of the power system and their subdivisions.
3. List and describe the systems included in the group shunt compensators FACTS.
4. UPFC devices - application, connect to the system, advantages, disadvantages.
5. What are hybrid systems FACTS - characteristics, applications.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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