GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Power Engineering Electronics, PG_00038401		
Field of study	Electrical Engineering		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2022/2023
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Part-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	Polish
Semester of study	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Power Electronics and Electrical Machines -> Faculty of Electrical and Control Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Krzysztof Iwan	
	Teachers	dr inż. Krzysztof Iwan	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	10.0	0.0	10.0	0.0	0.0	20

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	20	8.0	72.0	100

Subject objectives

To learn analysis and understand principles of operation of basic power electronic elements and circuits.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U08	Student is able to define functions of the power electronic system and is able to design a simple converter system.	[SU1] Assessment of task fulfilment
K6_W10	Student knows operation priciples of devices and power electronic converters. He is able to specify the requirements that the power electronic system should meet in terms of disturbances and effective methods of their reduction.	[SW1] Assessment of factual knowledge
K6_W03	Student is able to explain and analyze operation of basic power electronic systems.	[SW3] Assessment of knowledge contained in written work and projects
K6_K01	Student is able to perform tasks and conducts laboratory tests as a part of team work.	[SK1] Assessment of group work skills
K6_U01	The student is able to use datasheets of power electronic components and knows the meaning of basic parameters. He can use available simulation programs.	[SU4] Assessment of ability to use methods and tools

Subject contents

LECTURE 1. The Significance of power electronics in the modern electricity. 2. Power electronic switches-review, structure, static and dynamic parameters, thermal model. 3. Modern semiconductor materials. 4. Diode rectifiers. 5. Thyristor controlled rectifiers. 6. Cycloconvertors. 7. Alternating Current controller. 8. DC-DC switch mode converters. 9. Theory of modulation applied for power converters. 10. Transistor inverters. 11. Resonant converters. 12. Multi-level inverters and matrix converters. 13. PWM rectifiers. 14. Series and parallel active filters. 15. Overview of chosen power electronic problems: power network distortion, UPS systems, PFC systems. LABORATORY 1. Alternating Current controller. 2. Single-Phase diode rectifiers. 3. Transformerless DC-DC converters. 4. Single-Phase voltage inverter.

Prerequisites and co-requisites	The Knowledge of theoretical rules and methods of analysis of electric circuits presented within the framework of lectures of "Electrical circuits". Knowledge of problems connected with semiconductor physics presented within the framework of lectures of "Electronic engineering".

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory	60.0%	40.0%
Examination	60.0%	60.0%

Recommended reading

Basic literature	1. Tunia H., Smirnow A., Nowak M., Barlik R.: Układy Energoelektroniczne. Warszawa: WNT 1998. 2. Nowak M., Barlik R.: Poradnik inżyniera energoelektronika. Warszawa: WNT 1998. 3. Mohan N., Undeland T.M., Robbins W.P., Power Electronics: Converters, Applications and Design, 3rd Edition, John Willey & Sons, Inc, 2003. 4. Kaźmierkowski M.P., Matysik J.T., Wprowadzenie do elektroniki i energoelektroniki. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2005. 5. Tunia H., Winiarski B.: Energoelektronika. WNT, Warszawa 1994.
Supplementary literature	1. Opolski A: Zadania z energoelektroniki część I prostowniki, Wydawnictwo PG 1994. 2. Musznicki P., Turzyński, M., Racewicz Sz.: Przekształtniki energoelektroniczne DC - DC,Wydawnictwo PG 2012. 2. http://ieeexplore.ieee.org/ 3. http://www.ipes.ethz.ch/
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed

1. Power diodes - basic structure, parameters, static and switching characteristics, types and features.
2. Thyristors - basic structure, parameters, static and switching characteristics, types and features.
3. Power MOSFET's - basic structure, parameters, static and switching characteristics.
4. Insulated Gate Bipolar Transitors basic structure, parameters, static and switching characteristics, types and features.
5. Real power, active power and apparent power in power electronic systems.
6. 1 pulse line frequency diode rectifire - currents and voltages waveforms with R, RL, RE, RLD, RC loads. Basic relationships.
7. p- pulses one direction line frequency diode rectifire - properites, waveforms, basic relationships.
8. Single Phase bridge diode rectifire with R,RC,RL, RLE loads - basic concept, currents and voltages waveforms, basic relationships.
9. Three- Phase bridge diode rectifire with R load - basic concept, currents and voltages waveforms, basic relationships.
10. Thyristor controlled one - pulse rectifiers with RL, R and RE loads - principle of operation, currents and voltages waveforms, basic relationships.
11. Thyristor controlled two - pulse rectifiers with RL and R loads - principle of operation, currents and voltages waveforms, basic relationships.
12. Operation modes of the thyristor controlled rectifire with RLE load.
13. Thyristor controlled three - pulse rectifiers with R load - principle of operation, currents and voltages waveforms, basic relationships.
14. Alternating current controller with R and RL loads - principle of operation, currents and voltages waveforms, basic relationships.
15. DC-DC switch mode converters - boost and buck converters - basic concept, principle of operation, basic relationships, currents and voltages waveforms, modes of operation, basic characteristics.
16. Thyristor reversible converters - structure, principle of operation, practical applications.
17. Cycloconvertors - structure, principle of operation and strategy of control.
18. A single - phase bridge voltage inverter - structure, principle of operation, methods of control of the first harmonic of the output voltage.
19. PWM and PDM modulation.
20. A three - phase bridge voltage inverter.
21. A space vectror modulation - SVPWM.
22. Current inverters - structure, basic properties and features.
23. Resonant converters - pricniple of operation, basic features.
24. Matrix inverters - pricniple of operation, basic features.
25. Multi-levels inverters - pricniple of operation, basic features.
26. Controlled PWM rectifires - structure, principle of operation, basic features.
27. Grid distortions and active filtres - structures, types, principle of operation.
28. Multi pulses diode rectifires ATRU - structures, features.
29. PFC converters - practical applications, structures, basic features.
30. UPS converters - practical applications, structures, basic features.

Work placement	Not applicable