Politechnika Warszawska

UCZELNIA BADAWCZA
INICJATYWA DOSKONAŁOŚCI

Code of the course	4606-VP-ES-00007	Name of the course	Polish	**Konwersja energii elektrycznej**
			English	**Electric energy conversion**
Type of the course	Specialty subject			
Course coordinator	Professor Haitham Abu-Rub	Course teacher	Professor Haitham Abu-Rub	
Implementing unit	Fakulty of elektrical engineering	Scientific discipline / disciplines*	- automation, electronics, electrical engineering and space technologies; - physical sciences; - chemical engineering; - chemical sciences	
Level of education	Doctoral studies	Semester	Summer, March 15, 2025 to June 15, 2025	
Language of the course	English			
Type of assessment	pass	Number of hours in a semester	30	ECTS credits: 3
Minimum number of participants	10	Maximum number of participants		Available for students (BSc, MSc): Yes/No

Type of classes		Lecture	Auditory classes	Project classes	Laboratory	Seminar
Number of hours	in a week					
	in a semester	20		10		

* does not apply to the Researcher's Workshop

1. Prerequisites

no prerequisites

2. Course objectives

Fundamental topics in electric power and energy conversion systems; single-phase and three-phase circuits; power transformers; electromechanical energy conversion systems; synchronous and induction machines; power electronics; solar and wind energy systems;

The objective of this course is to equip the students with an overview and fundamentals of energy conversion systems, electrical, electromechanical, and renewable.

3. Course content (separate for each type of classes)

Lecture

1. Introduction to energy conversion.
2. Power in single phase and three phase circuits.
3. Transformers.
4. Basics of power electronics converters.
5. Three phase AC machines (motors and generators).
6. Single phase machines.
7. Solar PV and wind energy systems.
8. Exams.

Class projects

1. Induction machine operating as motor and generator.
2. Synchronous generator, stand alone operation.
3. Parallel operation of synchronous generators.

4. DC motor, structure and control.
5. Single phase induction motor.
6. Photovoltaic (PV) system configuration and integration with the grid.
7. Wind energy conversion system and integration with the grid.
8. Current status and future perspectives of energy storage.
9. Impact of EV and wind integration on power system.
10. Bioenergy.
11. Ocean renewable energy

4. Learning outcomes			
Type of learning outcomes	Learning outcomes description	Reference to the learning outcomes of the WUT DS	Learning outcomes verification methods*
Knowledge			
K01	Understand the principles and importance of electric energy conversion systems in our life.	SD_W1	Exams
K02	Understand the single-phase and three-phase systems, transformers, and electrical machines.	SD_W2	Exams
K03	Understand the DC-DC conversion, DC-AC inversion and AC-DC rectification.	SD_W3	Exams
K04	Understand the operation of solar PV and wind renewable energy systems.	SD_W5, SD_W4	Exams
Skills			
S01	Explain the operation of three- phase machines and their applications.	SD_U1	Exams
S02	Is able to critically evaluate the profitability of investing in a photovoltaic system with energy storage taking into account economic, functional and environmental factors.	SD_U1, SD_U2, SD_U3	Exams
S03	Can critically evaluate both the advantages and disadvantages of the arrangement.	SD_U5	Exams
Social competences			
SC01	Takes care of the reliability of the solutions presented, the sustainability and environmental impact of the solutions. Understands the role of energy acquisition and storage in providing better living conditions for society.	SD_K3; SD_K5	Social competencies are assessed based on observation of behaviours and attitudes during the conducted classes
SC02	Able to prove the validity of assumptions made, accepts constructive criticism.	SD_K1	Social competencies are assessed based on observation of behaviours and attitudes during the conducted classes

*Allowed learning outcomes verification methods: exam; oral exam; oral test; project evaluation; report evaluation; presentation evaluation; active participation during classes; homework; tests

5. Assessment criteria
The scores for the class attendance, research assignment, and final examination.

6. Literature
Primary references: [1] *K. R. Davis, M. A. Pai, Power Circuits and Electromechanics, 2nd Ed, Champaign: Stipes Publishing, 2022.* (ISBN for the new edition: 978-1-64617-334-1) Secondary references: [1] Class Material [2] *Stephen J. Chapman, Electric Machinery Fundamentals*; 5th Edition, McGraw-Hill 2012. *Daniel W. Hart, Power Electronics*, 1st Edition, McGraw-Hill 2010.

7. PhD student's workload necessary to achieve the learning outcomes**		
No.	Description	Number of hours
1	Hours of scheduled instruction given by the academic teacher in the classroom	20
2	Students projects and presentation	10
2	Hours of consultations with the academic teacher, exams, tests, etc.	10
3	Amount of time devoted to the preparation for classes, preparation of presentations, reports, projects, homework	20
4	Amount of time devoted to the preparation for exams, test, assessments	15
	Total number of hours	**75**
	ECTS credits	**3**

** 1 ECTS = 25-30 hours of the PhD students work (2 ECTS = 60 hours; 4 ECTS = 110 hours, etc.)

8. Additional information	
Number of ECTS credits for classes requiring direct participation of academic teachers	2
Number of ECTS credits earned by a student in a practical course	1