COURSE SYLLABUS

Course code	1070-ICGTE-MSA-109
Course name	Energy Conversion & Storage
Course version	2026L
Level of education	second cycle programme
Form and mode of study	full-time study
Study profile	general academic profile
Field of study	Chemical and Process Engineering
Specialisation	Green Technologies in Chemical Engineering
Organizational unit	The Faculty of Chemical and Process Engineering
Implementing unit	The Faculty of Chemical and Process Engineering
Course unit	n/a
Course groups	-
Course status	Obligatory
Language of the course	English
Study stage code	ICZTC-S1-MSA-1070
Number of ECTS credits	2

Part I

01. Learning outcomes and the method of conducting classes

Learning outcomes	see table "Learning outcomes"
Forms of classes and the number of hours in the semester	
lectures	20.00 h

02. ECTS balance

Number of ECTS credits	2	
Course workload	**Hours**	**ECTS**
Total number of hours and ECTS credits for the course:		
Hours and ECTS credits for courses involving direct participation of academic teachers	30	1.20
Hours and ECTS credits involving student's independent work	20	0.80
Total	50	2.00
Number of hours involving direct participation of academic teachers:		
Hours connected with class participation	20	
Other synchronous hours	10	
Total	30	
Number of hours involving student's independent work:		
Hours for student's independent work	20	

03. Course content

Part I

Course content	1. Introduction: energy, exergy, energy use: I, II, III and the zeroth law of thermodynamics, exergy, exergy analysis. 2. Radiation thermodynamics. 3. Energy sources: non-renewable, renewable and unconventional energy: coal, oil, nuclear energy, water fall energy, wind energy, solar energy, geothermal energy, tidal energy, biomass, biogas. 4. Energy conversion: motors, heat pumps, chemical and fuel cells. 5. Solar energy conversion: photovoltaic cells, collectors, etc. 6. Converting energy obtained from water fall, wind, geothermal, tidal and magneto-hydrodynamic sources. 7. Risks related to the use of energy - environmental effects. 8. Waste energy. 9. Energy storage.

Table: Learning outcomes	
Knowledge	
Outcomes code	P_W02
Description	Students have in-depth knowledge of physics necessary to interpret physical phenomena in industrial processes
Related field-of-study learning outcomes	K2_W02
Outcomes code	P_W04
Description	Students have well-established knowledge necessary to prepare balances of mass, component, momentum and energy, taking into account the phenomena of momentum, mass and energy transfer.
Related field-of-study learning outcomes	K2_W04
Outcomes code	P_W05
Description	Students have theoretically based and well-established knowledge necessary to design processes and apparatuses in the processing industry.
Related field-of-study learning outcomes	K2_W05
Outcomes code	P_W09
Description	Students have knowledge of the directions of development of industrial technologies and the latest achievements in chemical and process engineering.
Related field-of-study learning outcomes	K2_W09
Skills	
Outcomes code	P_U01
Description	Students are able to obtain information from literature, databases and other sources in the field of chemical and process engineering, are able to integrate the obtained information, interpret and critically evaluate it, as well as draw conclusions and formulate and justify opinions.
Related field-of-study learning outcomes	K2_U01
Outcomes code	P_U02
Description	Students can communicate on topics related to chemical engineering in diverse social and professional environments and lead a debate.
Related field-of-study learning outcomes	K2_U02
Outcomes code	P_U07
Description	Students can model the physical operations and chemical processes leading in industrial apparatuses and equipments.
Related field-of-study learning outcomes	K2_U07
Outcomes code	P_U12

Part I	
Description	Student can take into account economic aspects in the design of industrial processes.
Related field-of-study learning outcomes	K2_U12
Outcomes code	P_U17
Description	Student are able to assess the usefulness of methods and tools used to solve an engineering task, characteristic of chemical engineering, and identify the limitations of these methods and tools.
Related field-of-study learning outcomes	K2_U17
Social competence	
Outcomes code	P_K01
Description	Students are ready to critically evaluate their knowledge and improve it using various sources of information.
Related field-of-study learning outcomes	K2_K01
Outcomes code	P_K02
Description	Students are ready to identify and correctly solve problems related to the engineering profession, observing the rules of ethics and taking care of professional achievements and its development.
Related field-of-study learning outcomes	K2_K02
Outcomes code	P_K05
Description	Students are aware of the importance of non-technical aspects and the effects of engineering activities, including its impact on the environment and the related responsibility for decisions made.
Related field-of-study learning outcomes	K2_K05

Part II	
04. Year and semester of studies	
Year	2026L
Semester	1
05. Course leader and course teachers	
lectures	Paweł Gierycz
lectures	Paweł Gierycz
06. Course objective	
Course objective	Introduction to the subject of energy processing and storage (the concept of energy, exergy, energy use, etc.), Getting to know non-renewable, renewable and unconventional energy sources. Getting to know the methods of processing energy obtained from renewable and unconventional sources, Getting to know the possible risks related to the use of energy (environmental effects, including: waste energy and radioactive waste). Getting to know the methods of energy storage.
07. Teaching methods and techniques	
lectures	10 lectures (20 hours).
08. Methods of verifying learning outcomes	
Knowledge	
Outcomes code	P_W02
Description	Students have in-depth knowledge of physics necessary to interpret physical phenomena in industrial processes
Verification methods	lectures: written test
Outcomes code	P_W04

Part II

Description	Students have well-established knowledge necessary to prepare balances of mass, component, momentum and energy, taking into account the phenomena of momentum, mass and energy transfer.
Verification methods	lectures: written test
Outcomes code	P_W05
Description	Students have theoretically based and well-established knowledge necessary to design processes and apparatuses in the processing industry.
Verification methods	lectures: written test
Outcomes code	P_W09
Description	Students have knowledge of the directions of development of industrial technologies and the latest achievements in chemical and process engineering.
Verification methods	lectures: written test
Skills	
Outcomes code	P_U01
Description	Students are able to obtain information from literature, databases and other sources in the field of chemical and process engineering, are able to integrate the obtained information, interpret and critically evaluate it, as well as draw conclusions and formulate and justify opinions.
Verification methods	lectures: written test
Outcomes code	P_U02
Description	Students can communicate on topics related to chemical engineering in diverse social and professional environments and lead a debate.
Verification methods	lectures: written test
Outcomes code	P_U07
Description	Students can model the physical operations and chemical processes leading in industrial apparatuses and equipments.
Verification methods	lectures: written test
Outcomes code	P_U12
Description	Student can take into account economic aspects in the design of industrial processes.
Verification methods	lectures: written test
Outcomes code	P_U17
Description	Student are able to assess the usefulness of methods and tools used to solve an engineering task, characteristic of chemical engineering, and identify the limitations of these methods and tools.
Verification methods	lectures: written test
Social competence	
Outcomes code	P_K01
Description	Students are ready to critically evaluate their knowledge and improve it using various sources of information.
Verification methods	lectures: written test
Outcomes code	P_K02
Description	Students are ready to identify and correctly solve problems related to the engineering profession, observing the rules of ethics and taking care of professional achievements and its development.
Verification methods	lectures: written test
Outcomes code	P_K05

Part II	
Description	Students are aware of the importance of non-technical aspects and the effects of engineering activities, including its impact on the environment and the related responsibility for decisions made.
Verification methods	lectures: written test

09. Required and recommended reading list	
Required reading	1. B. Sorensen “Renewable Energy Conversion, Transmission, and Storage”, Academic Press, 2007. 2. Thomas Christen “Efficiency and Power in Energy Conversion and Storage. Basic Physical Concepts”, CRC Press, 2018.
Recommended reading	1. S.E. Manahan „Environmental Chemistry”, CRC Press, New York, 2005. 2. K.T Valsaraj, “Elements of Environmental Engineering: Thermodynamics and kinetics”, CRC Press, New York, 2000. 3. 3. S. Sieniutycz, J. Jeżowski. „Energy Optimization in Process Systems”, Elsevier, Oxford 2009.

10. Other information	
Other information	-