Energy Efficiency

Basic information

Field of study Renewable Energy and Energy Management **Speciality** All **Department** Faculty of Energy and Fuels **Study level** Second-cycle (engineer) programme **Study form** Full-time studies **Education profile** General academic	**Didactic cycle** 2021/2022 **Subject code** EiPEOZS.IIi1PJO.b8ef6c01d4c631f9a5f7772d77ca499b.21 **Lecture languages** English **Mandatory** Elective **Block** Elective Modules in Foreign Language **Subject related to scientific research** Yes

Subject coordinator	Magdalena Dudek
Lecturer	Magdalena Dudek, Andrzej Raźniak, Bartłomiej Lis

Period Semester 1	**Examination** Assessment **Activities and hours** Lecture: 15, Laboratory classes: 15, Project classes: 30	**Number of ECTS points** 5.0

Goals

C1	To familiarize students with problems about energy efficiency of the energy systems.
C2	Acquiring the ability to identify processes leading to a decrease in energy efficiency
C3	Transfer interdyscyplinary knowledge about new solution of distributed energy system with improved efficiency
C4	Create ability to techno-economic analysis of batteries and fuel cells system for hevay duty transport, electrical cars, marine and aviation
C5	Pratical creative skills to elaborated concept, design and operation of distributed low-carbon energy technologies

Subject learning outcomes

Code	Outcomes in terms of	Directional learning outcomes	Examination methods
Knowledge – Student knows and understands:			
W1	Student knows the methods of evaluating energy processes in classical and renewable energy	EOZ2A_W01, EOZ2A_W02, EOZ2A_W03	Test
W2	Student knows the optimization methods and their application in the power industry	EOZ2A_W06	Execution of a project, Presentation
Skills – Student can:			
U1	Student is able to perform analysis, apply appropriate optimization methods and solve practical technical and economic problems in the power industry	EOZ2A_U07	Test
U2	Student can assess the impact of energy systems on the functioning of the environment, social development and the economy	EOZ2A_U02, EOZ2A_U07	Execution of a project, Execution of laboratory classes, Presentation
U3	Student is able to solve practical problems regarding energy efficiency	EOZ2A_U02	Execution of laboratory classes
Social competences – Student is ready to:			
K1	Student thinsk in a creative and entrepreneurial way	EOZ2A_K01	Execution of a project, Test, Presentation
K2	Is able to set priorities in the implementation of tasks	EOZ2A_K02	Execution of a project

Programme content that ensure achieving learning outcomes for the module

Analysis of energy consumption in the world; Energy efficiency in production engineering; Transport energy efficiency; Energy efficiency in buildings; Energy efficient lighting; Methods of energy efficiency improvment and cost saving opportunities; Basic regulations and instruments to suppor energy efiiciency in UE countries

Calculation of ECTS points

Activity form	**Average amount of hours* needed to complete each activity form**
Lecture	15
Laboratory classes	15
Preparation for classes	20
Examination or Final test	2
Preparation of project, presentation, essay, report	48
Project classes	30
Student workload	**Hours** 130

Workload involving teacher	Hours 60

* hour means 45 minutes

Study content

No.	Course content	Subject learning outcomes	Activities
1.	Topic of Lectures: 1.Analysis of energy consumption in the world 2.Energy efficiency in production engineering 3.Transport energy efficiency 4.Energy efficiency in buildings 5.Energy efficient lighting 6.Methods of energy efficiency improvment and cost saving opportunities 7.Basic regulations and instruments to suppor energy efiiciency in UE countries	W1, U1, K1	Lecture
2.	Energy efficiency project classes: The topics of project refer to the issue of energy efficiency and the rational use of energy. The purpose of this assumption is that students shall acquire in this way the knowledge and skills necessary for diagnostic and calculating the energy efficiency of equipment and services.	W2, U1, U2, K1, K2	Project classes
3.	Laboratory classes Performing the following practical measuring exercises: 1.Measurement of efficiency of different light sources. 2.Measurement of efficiency of various full cell stack cooling system. 3.Measurement of efficiency of DC / AC converter under various load. 4.Determining the efficiency of the DC / DC converter under various load. 5.Evaluation of conversion efficiency battery charge regulator in PV system with and without maximum power point tracking system.. 6.Measurements of pump performance in various conditions.	W2, U2, U3, K2	Laboratory classes

Course advanced

Teaching methods:

Lectures, Blackboard exercises, Laboratory classes, Multimedia presentation, Discussion, Project assignments, E-learning

Activities	Examination methods	Credit conditions
Lecture	Test	Pass the test (positive grade >50%)
Lab. classes	Execution of a project, Presentation	Project preparation and multimedia presentation
Project classes	Execution of laboratory classes	Performing all exercises and preparing reports

Additional info

Audiovisual recording of the lecture requires the teacher's consent.

Requirements and method of completing particular forms of classes

Lectures: Students participate in classes learning the next teaching content according to the subject syllabus.
Students should keep asking questions and clarifying doubts.
The student must perform all laboratory exercises and prepare reports. The student must prepare and present the project results.

Method of calculating the final grade

Final mark (FM) is calculated as an average of mark of clases: laboratory (L), project (P) and tests (T)
FM = 0.34 T + 0.33 P + 0.33 L, T-test, project-P and L-laboratory
Grades indicate that a student is able to understand real problems related to energy efficiency, can transform them into research problems and (in reference to EIT OLO 6):
5.0 - find solutions to address all problems related to energy efficiency in the energy system considered (comprehensive knowledge and practical skills),
4.5 - find solutions to address and solve main problems related to energy efficiency in the energy system considered ,
4.0 - find solutions to address and solve some problems related to energy efficiency in the energy system considered,
3.5 - combine a collection of available ideas to address and solve some problems related to energy efficiency in the energy system considered,
3.0 - reformulate and apply only basic ideas to address and solve some problems related to energy efficiency in the energy system considered,
2.0 - no evidence of the Learning Outcomes shown

Method and procedure for compensating for missed coursework resulting from student absence from classes

Absences during lectures and project classes. Own student work to supplement knowledge and project materials. Catching up all the backlog, based on individual guidelines from the teacher after agreeing with the teacher.
Performing laboratory exercises on an additional date.

Entry requirements

Student has a basic knowledge of energy use and energy conversion processes.

Attendance requirements for particular classes, with indication whether student attendance is compulsory

Attendance at lectures is recommended. Laboratories and Project classes attendance are compulsory fot the student.

Literature

Obligatory

1. Goswami, D. Yogi, and Frank Kreith, eds. Handbook of energy efficiency and renewable energy. Crc Press, 2007.
2. Goswami, D. Yogi, and Frank Kreith, eds. Energy efficiency and renewable energy handbook. CRC Press, 2015.
3. Fawkes, Steven. Energy efficiency: the definitive guide to the cheapest, cleanest, fastest source of energy. Routledge, 2016.

Optional

1. Energy Efficiency (eJournlal - Springer) Energy efficient design of building: A review, Renewable and Sustainable Energy Reviews 16 (2012) 3559-3573

Research and publications

Research

1. Battery Electric Vs Hydrogen Fuel Cell: Efficiency Comparison for transport application
2. Energy efficiency of combined and heat power system involving fuel cells supllied by hydrogen and allternative fuels
3. Energy efficiency of grid on or grid off system with rewenable energy sources, hydrogen and fuel cells

Publications

1. Determination of electrical and efficiency parameters of air cooling of low-temperature PEM fuel cell stack with power of 5kW — / Andrzej RAŹNIAK, Magdalena DUDEK, Tomasz SIWEK, Piotr DUDEK, Wojciech KALAWA // Przegląd Elektrotechniczny / Stowarzyszenie Elektryków Polskich ; ISSN 0033-2097. — 2018 R. 94 nr 4, s. 140–147. — Bibliogr. s. 147
2. A 360W laboratory electric power generator incorporating a low-temperature PEMFC fuel cell stack cooled using a liquid medium / Magdalena DUDEK, Piotr Celowski, Bartłomiej LIS, Andrzej RAŹNIAK, Piotr DUDEK // Przegląd Elektrotechniczny;ISSN 0033-2097. — 2016 R. 92 nr 10, s. 235–242.
3. Temperature monitoring of biomass boiler chamber and heating installation / Mariusz FILIPOWICZ, Magdalena DUDEK, Andrzej RAŹNIAK, Wojciech GREGA, Wojciech KREFT, Maciej ROSÓŁ // Ciepłownictwo Ogrzewnictwo Wentylacja ; ISSN 0137-3676. — 2011 t. 42 nr 7–8, s. 310–316. — Bibliogr. s. 316, Streszcz., Abstr.
4. Adapter for transferring hydrogen from a stationary tank to portable cylinders, Magdalena DUDEK, Andrzej RAŹNIAK, Bartłomiej LIS, utility model PL 70996, 30.09.2019 WUP 09/19
5. Monitoring of the operating parameters a low-temperature fuel-cell stack for applications in unmanned aerial vehicles, Pt. 1 / Magdalena DUDEK, Andrzej RAŹNIAK, Bartłomiej LIS, Tomasz SIWEK, Bartosz ADAMCZYK, Dagmara Uhl, Wojciech KALAWA, Tadeusz UHL // E3S Web of Conferences 2019 vol. 108 art. no. 01029, s. 1–14.
6. Monitoring of the operating parameters of low-temperature fuel-cell stack for applications in unmanned aerial vehicles, Pt. 2 / Magdalena DUDEK, Andrzej RAŹNIAK, Bartłomiej LIS, Tomasz SIWEK, Bartosz ADAMCZYK, Dagmara Uhl, Wojciech KALAWA, Tadeusz UHL // E3S Web of Conferences, 2019 vol. 108 art. no. 01030, s. 1–10.
7. Cooling system for fuel cells in the pilotless propeller-driven aircraft, Magdalena Dudek, Barłomiej Lis, Piotr Tomczyk, 068768 PL, utility model 30.12.2016 WUP12/2016
8. Electric motor-glider powered by a hydrogen fuel cell stack / Piotr Czarnocki, Magdalena DUDEK, Krzysztof Drabarek, Wojciech Frączek, Grzegorz Iwański, Tomasz Miazga, Marcin Nikoniuk, Andrzej RAŹNIAK, Maciej ROSÓŁ // MATEC Web of ConferencesI, ISSN 2261-236X. — 2019 vol. 304 art. no. 03011, s. 1–8

Directional learning outcomes

Code	Content
EOZ2A_K01	Is aware of the need to critically assess the information received and knowledge acquired, recognizes the importance of knowledge in addressing cognitive and practical problems, in particular in the field of energy.
EOZ2A_K02	Is aware of responsibility for the tasks performed, is willing to think and act in an entrepreneurial and professional manner, is aware of compliance with the principles of professional ethics and the cultivation and dissemination of appropriate practices, as well as initiation of actions for the benefit of the social community and public interest, including the rational use of energy and provision of the national energy security.
EOZ2A_U02	Is able to use knowledge to plan and conduct research on energy processes using various methods, including experimental ones, is able to use available software and create own computer codes for the purpose of analysis of the solution, is able to perform a critical analysis of results and prepare a synthetic compilation presenting the results of conducted research in terms of economic and environmental analysis.
EOZ2A_U07	Is able also to assess the impact of energy systems on the global functioning of civilization, including society, natural environment, economic and social development and related issues, is able to present own point of view to a wide range of audiences, also using a foreign language and presentations illustrating advanced technical and non-technical problems in the field of energy.
EOZ2A_W01	Knows and understands the phenomena described in the basic sciences, methods of their thermodynamic description and modelling in connection with the use of materials in the power industry.
EOZ2A_W02	Knows and understands basic and advanced processes occurring during the operation and functioning of machines, networks and power and electrical systems that use renewable energy sources, the importance of automation and control of their operation, the importance of proper design and selection, forecasting and planning of their development and the impact of energy technologies on the environment.
EOZ2A_W03	Knows and understands development trends in fields related to renewable energy, such as processing of energy resources, co-generation, environmental protection technologies and modern information and optimization methods that broaden the application horizon of RES.
EOZ2A_W06	Knows and understands the general principles for developing individual entrepreneurship, including: principles of business plan development and business management, economics and management in the energy sector and environmental protection.