Energy and Environment

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.IIi1S.66832f7ea27e8893ba4bb204c46aa1d6.21 **Lecture languages** English **Mandatory** Obligatory **Block** Major Modules **Subject related to scientific research** Yes

Subject coordinator	Magdalena Dudek
Lecturer	Magdalena Dudek, Bogdan Samojeden, Janusz Zyśk

Period Semester 1	**Examination** Assessment **Activities and hours** Lecture: 20, Laboratory classes: 30, Project classes: 25	**Number of ECTS points** 6.0

Goals

C1	1. To familiarize students with environmental impact assessment of energy sector.
C2	2 Transfer of knowledge to students about Catalysts for removal of NOx and volatile organic compounds from flue gases (from the power plants)
C3	3. Development skills of pratical analysis of problems of energy converison from natural sources
C4	4. Complementary analysis in the intedyscplinary aspects of possibility of development of hydrogen economy as a clean energy path
C5	5. Development skills of analysis of energy efficiency of eco-friendly systems in power sector

Subject learning outcomes

Code	Outcomes in terms of	Directional learning outcomes	Examination methods
Knowledge – Student knows and understands:			
W1	Knows and understands dilemmas related to the development of RES: ensuring energy security, environmental protection and sustainable energy development as well as rational utilization of energy and use of energy resources.	EOZ2A_W04	Activity during classes, Test, Report, Engineering project
W2	Knows and understands the norms and legal regulations applied in the power industry, the concepts in the field of industrial property protection, copyrights and patent information, the basis of economics and management in renewable energy and environmental protection.	EOZ2A_W05	Activity during classes, Test, Report, Engineering project
W3	Knows and understands the general principles of economics and management in the energy sector and environmental protection	EOZ2A_W06	Activity during classes, Test, Report, Engineering project
Skills – Student can:			
U1	Is able to carry out critical, from the technical, economic, environmental and social point of view - analysis of the functioning of any element of the energy system and develop a project of improvement in the construction and operation of renewable and classic energy equipment and installations	EOZ2A_U05	Activity during classes, Test, Report, Engineering project
U2	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_U07	Test, Engineering project, Preparation and conduct of scientific research
U3	Is able to develop a complete project involving machinery, equipment and energy installations, including also relevant automation, control, monitoring and process visualisation systems using a wide range of modern technical, IT and data transmission tools.	EOZ2A_U06	Engineering project
Social competences – Student is ready to:			

K1	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_K01	Activity during classes, Test, Engineering project, Preparation and conduct of scientific research
K2	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_K02	Activity during classes, Test, Engineering project, Preparation and conduct of scientific research

Programme content that ensure achieving learning outcomes for the module

The lectures, laboratories and projects are aimed to transfer interdyscplinary knowledge about enviroment and energy systems.

Calculation of ECTS points

Activity form	**Average amount of hours* needed to complete each activity form**
Lecture	20
Laboratory classes	30
Project classes	25
Preparation for classes	20
Preparation of project, presentation, essay, report	30
Realization of independently performed tasks	20
Examination or Final test	2
Contact hours	5
Student workload	**Hours** 152
Workload involving teacher	**Hours** 75

* hour means 45 minutes

Study content

No.	**Course content**	**Subject learning outcomes**	**Activities**

1.	Regulatins and policy Energy regulations, emission standards, best available technologies, politics, energy and climate goals. Environmental policy instruments. Time duration 1.5 h	W2	Lecture
2.	Air quality Air quality in selected regions, quality indicators (UE, WHO), types of pollutions, emission sources, emission standards, impact of sectors on air quality, transformation of pollutants in the atmosphere, atmosphere structure and meteorological conditions, measurement networks, actions taken to improve air quality. Time duration : 1.5 h	W3	Lecture
3.	Air quality modelling Modelling systems dedicated to air pollution dispersion (goals, advantages and disadvantages, types, input and output data, physical and chemical transformations, deposition). Impact of meteorological conditions on air pollution transport. Time duration 1.5 h	W1, W3	Lecture
4.	Impact on health and the environment. Impact of pollution exposure on human health, impact of deposition on acidification of ecosystems and eutrophication, valuation of environmental and health effects, external costs of the energy sector. Time duration 1.5 h	W2, W3	Lecture
5.	Greenhouse gases, Applicable legal regulations regarding greenhouse gas emissions. Time duratin 1.5 h	W1, W2	Lecture
6.	Advanced technological option for coal conversion. Advanced clean coal technologies. Gasification of the coal. Coal converison to liquid and gaseous fuels. Integrated gasification combined cycles. Synergy of nuclear energy and fossil fuels. Time duration : 1.5 h	W1, W2, W3	Lecture
7.	Methods for removing pollutants on an industrial scale. Time duration 1.5 h	W1, W2	Lecture
8.	Clean energy technologies : Modern fossil -fuel power systems. Combined heat and power systems (CHP). Low and near-zero emission power technologies. Oxy-fuel combustion and chemical looping technologies. Time duration 1.5 h	W1, W2	Lecture
9.	Rewenable energy and hybrid system in domestic, transport and stationary application. Time duration: 1.5 h	W1, W3	Lecture
10.	Decarbonization of urban space . Energy and buildings, improvment of household energy use. Green transportation system. Intellignet buildings. Recycling, reuse and municipal waste disposal. Distric heat and cooling. Heat storage methods. MIcropower systems. Time duration: 1.5 h	W1, W2, W3	Lecture

11.	Hydrogen as a fuel or energy carrier. Intoduction to hydrogen economy. Methods of hydrogen production ("grey hydrogen", "green hydrogen" and biohydrogen methods productions. Hydrogen storage technologies. Power to gas, power to liquid technologies. Hydrogen for stationary and transport applications. Conception of "hydrogen grid ". Time duration: 1.5 h	W1, W2, W3	Lecture
12.	Strategy of waste mangament for thier utlization in energy production systems. The clasical routes of waste conversion will be presented. The new devlopment method for production syntheic fuel and energy by electrochemical routes Time duration: 1.5 h	W1, W2, W3	Lecture
13.	Ecological soutions for propulsions units in heavy-duty transports, cars , marine and aviations applications The technical, economical and enviromental aspects. Time duration: 1.5 h	W1, W2, W3	Lecture
14.	During project classes students will work on the case study concerning evaluation of environmental impact of given power plants/emission sources. They will develop a Gaussian model of air pollution dispersion in the Matlab environment. The model will give the opportunity to determine the impact of sources on air quality as well as to determine the dependence of various factors (emissions, metrological conditions, terrain) on the dispersions of air pollutants. In the next part of the project, students will simulate transport of air pollution with the use of the Eulerian type model. These simulations run will allow you to specify the impact of the single sources, energy sector or selected regions on the concentration and deposition of air pollution. Students based on the obtained concentration results will estimate the health effects and external costs. In the part Energy students will be asked to solve real technical tasks in the field of integrated eco-friendly system with improved efficieny. The topics will be correspond to lectures and laboratories. Student will create postive interdyscplinary thinking about modern power enginnering sector	U1, U2, U3, K1, K2	Project classes
15.	Laboratory 1Preparation of catalysts for DeNOx 2Removal of nitrogen oxides from flu gases - SCR 3Removal of phenol from industrial water waste 4Removal of heavy metals from industrial water waste 5 Production of energy in the steam machine 6Technology of storage energy and heat 7Micro-CHP unit involving PEMFC stack 8Testing of small hybrid PV pannels/wind turbine hybrid system 9 Enviromental pollution in transport sector (combustion engines, hybrid combustion engine-battery system, battery system-fuel cells supplied by hydrogen or methanol)	U1, U2, U3, K1, K2	Laboratory classes

Course advanced

Teaching methods:

Lectures, Laboratory classes, Multimedia presentation, Discussion, Group work method, Design thinking, Problem based learning, Project based learning

Activities	Examination methods	Credit conditions
Lecture	Activity during classes, Test	pass the test, activity in discussion during lectures
Lab. classes	Report, Preparation and conduct of scientific research	do pratical exercises, correct reports
Project classes	Engineering project	positive mark from project (concept, calculations,conclusion)

Requirements and method of completing particular forms of classes

Credit conditions for the courseLectures : positve mark from test (T) Laboratory : pratical performance of laboratory exercise, elaborating experimental data acording to instructions andpreparing report, positive mark from all reports (L). Students should participate in lectures, the obligatory participation of students in laboraotory and project classes is required Project - providing corect solution of technical task (concept, calculation and description)

Method of calculating the final grade

Method of calculating the final grade. The final mark of the subject will be calculated from the formula: 0.4 * T + 0.3 * L + 0.3 * P and it applies to all dates ofcreditingT-test, L-Laboratory, P-project. The final grade is determined to two decimal places without rounding. In accordance with the following rule depending onthe numerical value : 1) from 3.0 verbal rating : sufficient (3.0) , 2) from 3.21 verbal mark: plus sufficent (3.5), 3)from 3.71 verbal mark: good (4.0) 4) from 4.21verbal mark :plus good (4.5), 5) from 4.71 verbal mark: very good (5.0)
5.0 - is able to identify environmental impacts of considered energy system,
4.5 - is able to identify major environmental impacts of considered energy system,
4.0 - is able to identify some environmental impacts of considered energy system,
3.5 - shows awareness of some environmental impacts of considered energy system,
3.0 -shows only limited awareness of some environmental impacts of considered energy system,
2.0 - no evidence of the Learning Outcomes shown.

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

Method and procedure for compensating for missed coursework resulting from student absence from classesA student who was absent from classes is required to pass laboratory classes on the date agreed with the staff. A student who, due to random reasons, was absent from project classes, is also obliged to complete the arrears by the dateindicated by the teacher

Entry requirements

basic knowledge from chemistry, physiscs and energy conversion

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

Credit conditions for the course Lectures : positve mark from test, obligatory :yes Laboratory : pratical performance of laboratory exercise, elaborating experimental data acording to instructions andpreparing report, positive mark from all reports, obligatory : yes
Project - solving corectly the pratical task (concept, calculation and description), obligatotry : yes

Literature

Obligatory

1. F. Kreith, D.Y. Goswani: Handbook of Energy Efficiency and Renewable Energy, CRC Press, 2007
2. B.Everett, J. Ramage: Energy Systems and Sustainability, Oxford 2003
3. M.F. Hodreski: Hydrogen & Fuel Cells: Advances in Transportation and Power, CRC Press, 2009
4. S. A. Rosa, A.G. Jhaveri: Carbon Reduction: Policies, Strategies and Technologies, CRC Press, 2009
5. J. J. Peirce, P. A. Vesilind, R. Weiner: Environmental Pollution and Control, 4-th Ed., Butterworth-Heinemann, 1998

Optional

1. D. A. Bell, B. F. Towler: Coal Gasification and Its Application, Elsevier, 2010
2. Santhanam K. S. V. Introduction to Hydrogen Technology John Wiley
3. Fuel cells and electrochemical power sources, (each book)

Research and publications

Research

1. Catalysts for removal of NOx from flue gases (from the power plants)
2. Catalysts for process of chemical utilisation of carbon dioxide
3. Environmental impact assessment of energy sector
4. Hydrogen economy

Publications

1. The influence of the modification of carbonaceous materials on their catalytic properties in SCR-NH3 : a short review / Bogdan SAMOJEDEN, Monika MOTAK, Teresa GRZYBEK // Comptes Rendus Chimie ; 2015 vol. 18, 1049–1073.
2. The influence of the promotion of N-modified activated carbon with iron on NO removal by NH3-SCR (Selective catalytic reduction) // Energy 2016 vol. 116, 1484–1491
3. The influence of holmium on catalytic properties of Fe or Cu-modified vermiculites / Bogdan SAMOJEDEN, Grzybek TERESA, Joanna KOWAL, Agnieszka SZYMASZEK, Magdalena Jabłońska, Roger Gläser, Monika MOTAK // Physicochemical Problems of Mineral Processing, 2019 vol. 55 , 1484–1495.
4. Synthesis and characterization of halloysite/carbon nanocomposites for enhanced NSAIDs adsorption from water / Beata Szczepanik, Nina Rędzia, Laura Frydel, Piotr Słomkiewicz, Anna Kołbus, Katarzyna STYSZKO, Tadeusz DZIOK, Bogdan SAMOJEDEN // Materials 2019 vol. 12 iss. 22 art. no. 3754, s. 1-23
5. J. Zysk, Y. Roustan i A. Wyrwa. “Modelling of the atmospheric dispersion of mercury emitted from the power sector in Poland”. W: Atmospheric Environment 112, 2015, pp. 246–256.
6. Zysk J., Wyrwa A. i Pluta M. “Emissions of mercury from the power sector in Poland, Atmospheric Environment 45.3, 2011, pp. 605–610.
7. Biomass fuels for direct carbon fuel cell with solid oxide electrolyte / Magdalena DUDEK, Piotr TOMCZYK, Robert Socha, Marek Skrzypkiewicz, Janusz Jewulski // International Journal of Electrochemical Science (Online) [Dokument elektroniczny]. — Czasopismo elektroniczne ; ISSN 1452-3981. — 2013 vol. 8 iss. 3, s. 3229–3253.

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_U05	Is able to carry out critical, from the technical, economic, environmental and social point of view - analysis of the functioning of any element of the energy system and develop a project of improvement in the construction and operation of renewable and classic energy equipment and installations.
EOZ2A_U06	Is able to develop a complete project involving machinery, equipment and energy installations, including also relevant automation, control, monitoring and process visualisation systems using a wide range of modern technical, IT and data transmission tools.
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_W04	Knows and understands dilemmas related to the development of RES: ensuring energy security, environmental protection and sustainable energy development as well as rational utilization of energy and use of energy resources.
EOZ2A_W05	Knows and understands the norms and legal regulations applied in the power industry, the concepts in the field of industrial property protection, copyrights and patent information, the basis of economics and management in renewable energy and environmental protection.
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.