COURSE DESCRIPTION CARD - SYLLABUS

Course name
Alternative fuels in transport [S2Elmob1>PAwT]

Course

Field of study
Electromobility

Year/Semester
2/3

Area of study (specialization)
Energy Processing Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

1,00

Coordinators

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Lecturers

Prerequisites

The student has a basic knowledge of engines used in means of transport, is aware of the consumption of a significant part of natural energy resources by transport and the need to use them sustainably and is able to integrate the information obtained, interpret it, draw conclusions, formulate and justify opinions.

Course objective

Familiarizing the student with the reasons of research and development of alternative fuels in transport, sources (raw materials) and production technologies of these fuels, their physicochemical properties, operational evaluation and economic and ecological aspects of their use.

Course-related learning outcomes

Knowledge:
The student has general knowledge of environmental protection problems related to the implementation of selected chemical processes used in the recycling of materials and substances used in electromobility and the use of alternative fuels. He/she has knowledge of development trends, new achievements in the field of electromobility and dilemmas of modern civilization, especially in terms of the impact of changes in the ways of powering vehicles on the environment.

Skills:
The student is able to, when formulating and solving engineering tasks, take into account unpredictable conditions, the given technical specification and non-technical criteria, ensuring the savings of raw materials and energy as well as the security of IT systems of electric vehicles.

Social competences:
The student understands that in the area of technology, knowledge and skills are rapidly devaluing, which requires their constant supplementation. He/she is aware of the importance of the latest scientific and technical achievements in solving research and practical problems and, if necessary, supporting himself with expert opinions.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Credit on the basis of the final colloquium on the entire material, lasting about 60 minutes, consisting of test and open questions, scored differently. Passing threshold: 50% of points. The issues on the basis of which the questions are developed will be successively indicated to the Students during the classes.

Programme content

World energy resources and their consumption
World resources and consumption of various energy carriers. Major producers and importers of crude oil. Factors determining the demand for particular types of fuels. Consumption of motor fuels in the world, Europe and Poland. Forecasts of changes in demand for various engine fuels.
Classification and operational characteristics of engine fuels
Division of engine fuels into conventional and alternative. Overview of parameters describing the properties of fuels for spark ignition (SI) and compression ignition (CI) engines. Qualitative evolution of conventional fuels, reformulated fuels. Review of normative acts regulating the quality of conventional fuels. Toxicology of engine fuels.
Gaseous fuels
Gaseous fuels in historical terms (illuminating gas, generator gas). Sources of obtaining the main gaseous fuels i.e. LPG and CNG. Biogas as engine fuel. Factors shaping the suitability of gaseous fuels for fueling SI and CI engines. Physicochemical properties and normative requirements for gaseous fuels. Gas fuel supply systems, engine adaptation to gas fuel supply. Technical, operational and economic aspects of using LPG and CNG gaseous fuels to power internal combustion engines. Influence of the use of gaseous fuels on the toxicity of engine exhaust gases. Performance of gas-powered vehicles.
Alcohols
Analysis of the properties of alcohols in terms of their possible use as components and independent motor fuels. Overview of properties and methods of obtaining: methanol, ethanol and butanol. Raw materials for production. Characteristics of E85 fuel. Adaptation of the internal combustion engine to be powered by alcohol fuels. Construction and performance of flexi-fuel vehicles. Review of technical and operational benefits and risks associated with the use of alcohol fuels to power internal combustion engines. Influence of the use of alcohol fuels on the toxicity of engine exhaust gases. Economic and legal aspects of production and use of alcohol fuels.
Vegetable oils and their derivatives
Raw materials for the production of vegetable oils used in the production of fuels. Problems of fuelling engines with neat vegetable oils. Adaptation of a diesel engine to be powered by rapeseed oil. Production technology of fatty acid methyl esters of vegetable oils (FAME). Physicochemical properties and normative requirements for FAME. Review of technical and operational benefits and risks associated with use of FAME in diesel engines, in particular the impact of FAME on toxicity of engine exhaust gases. Economic and legal aspects of the production and use of FAME.
Hydrogen
Hydrogen production technologies. Physicochemical properties of hydrogen as motor fuel, comparison with other conventional and alternative fuels, advantages and disadvantages of hydrogen as motor fuel. Hydrogen supply systems for internal combustion engines, engine adaptation to hydrogen supply. Operating indicators of hydrogen-powered engines.
Synthetic fuels and other advanced alternative fuels
Synthetic fuels. Fischer-Tropsch synthesis. E-fuels, Power-to-Gas and Power-to-Liquid technologies. Ammonia as engine fuel. Fuels from waste pyrolysis. Higher generation biofuels. Oxygenated fuels and

components. Forecasts on development of fuels for internal combustion engines. National and EU legal acts regarding the development of transport fuels.

Course topics

none

Teaching methods

Lecture with multimedia presentation, discussion on the discussed topics.

Bibliography

Basic:
1. K. Baczewski, T. Kałdoński: Paliwa do silników o zapłonie samoczynnym, WKiŁ Warszawa 2017.
2. K. Baczewski, T. Kałdoński: Paliwa do silników o zapłonie iskrowym, WKiŁ Warszawa 2017.
3. A. O'Connell, M. Prussi, M. Padella, A. Konti, L. Lonza: Advanced Alternative Fuels Technology Development Report 2018, European Commission, Luxembourg 2019.

Additional:
1. M. Kozak: Studium wpływu komponentów tlenowych oleju napędowego na emisję toksycznych składników spalin z silników o zapłonie samoczynnym, Wydawnictwo Politechniki Poznańskiej, Poznań 2013.
2. K. Romaniszyn: Alternatywne zasilanie samochodów benzyną oraz gazami LPG i CNG, WNT Warszawa 2007.
3. J. Surygała: Wodór jako paliwo, WNT Warszawa 2007.
4. P. Richards: Automotive Fuels Reference Book, SAE International 2014.
5. Magazine 'Combustion Engines' (open access): www.combustion-engines.eu.

Breakdown of average student's workload

	Hours	ECTS
Total workload	28	1,00
Classes requiring direct contact with the teacher	15	0,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	13	0,50