COURSE DESCRIPTION CARD - SYLLABUS

Course name
Alternative fuels in transport [N1Trans1>PAwT]

Course

Field of study
Transport

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
18

Laboratory classes
9

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr hab. inż. Miłosław Kozak prof. PP
miloslaw.kozak@put.poznan.pl

Lecturers

Prerequisites

KNOWLEDGE: the student has a basic knowledge of conventional engine fuels and the main fuel requirements of modern internal combustion engines. SKILLS: the student is able to integrate the obtained information, interpret it, draw conclusions, formulate and justify opinions. SOCIAL COMPETENCES: the student is aware of the consumption by transport of a significant part of natural energy resources and the need to use them in a sustainable way.

Course objective

To acquaint students with the reasons for the search for alternative fuels for transport applications, 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:
1. has a basic knowledge of the life cycle of the means of transport, both hardware and software, and in particular about the key processes taking place in them.
2. knows the basic techniques, methods and tools used in the process of solving tasks in the field of

transport, mainly of an engineering nature.

Skills:
1. is able to obtain information from various sources, including literature and databases, both in Polish and in English, integrate them properly, interpret and critically evaluate them, draw conclusions and exhaustively justify their opinions.
2. is able to properly plan and perform experiments, including measurements and computer simulations, interpret the obtained results, and correctly draw conclusions from them.

Social competences:
1. is aware of the social role of a technical university graduate, in particular understands the need to formulate and transfer to the society, in an appropriate form, information and opinions on engineering activities, technological achievements, as well as the achievements and traditions of the profession of a transport engineer.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Grade for discussion, ongoing preparation and activity in the classroom. Grade for laboratory reports. Exam on the entire material. Final credit of laboratory classes.

Programme content

The world"s energy resources and their consumption
World resources and consumption of various energy carriers. Main producers and importers of crude oil. Factors determining the demand for individual types of fuel. 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. Review of parameters describing the properties of fuels for SI and CI engines. Qualitative evolution of conventional fuels, reformulated fuels. Review of legal acts regulating the quality of conventional fuels. Engine fuels toxicology.
Gaseous fuels
Gaseous fuels in the historical perspective (light gas, producer gas). Sources of main gaseous fuels acquisition – LPG and CNG. Biogas as an engine fuel. Factors influencing the suitability of gaseous fuels to power diesel and diesel engines. Physicochemical properties and standard requirements for gaseous fuels. Gaseous fuel supply systems for SI and CI engines, adaptation of the engine 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 the possibility of using them as components and independent motor fuels. Detailed review of the properties and methods of obtaining: methanol, ethanol and butanol. E85 fuel characteristics. Adaptation of the combustion engine SI and CI to run on alcohol fuels. Construction and performance of flexi-fuel vehicles. Overview of technical and operational benefits and threats related to the use of alcoholic fuels to power internal combustion engines. The influence of the use of alcoholic fuels on the toxicity of engine exhaust gases. Economic and legal aspects of production and use of alcoholic fuels.
Vegetable oils and their derivatives
Properties of vegetable oils used in the production of fuels: rapeseed, soybean, sunflower and palm. Problems of powering engines with pure vegetable oils. Adaptation of a compression ignition engine to be fed with rapeseed oil. Production technology of vegetable oil fatty acid methyl esters (FAME). Physicochemical properties and standard requirements for FAME. Overview of the technical and operational benefits and risks of using FAME in diesel engines, in particular the impact of using FAME on the toxicity of engine exhaust gases. Economic and legal aspects of the production and application of FAME.
Hydrogen and other fuels of the future
Technologies for obtaining hydrogen. Physicochemical properties of hydrogen as engine fuel, comparison with other conventional and alternative fuels, advantages and disadvantages of hydrogen as engine fuel. Hydrogen supply systems for combustion engines, adaptation of the engine to hydrogen

supply. Second and higher generation biofuels. Synthetic fuels. Fuels and oxygen components. Forecasts on the development directions of fuels for internal combustion engines. National and EU legal acts regarding the development of transport fuels.

Course topics

none

Teaching methods

1. Lecture with multimedia presentation, discussion on the topics discussed.
2. Table exercises supplemented with a multimedia presentation.
3. Laboratory ¬ practical laboratory exercises according to the program of the subject.

Bibliography

Basic
1. K. Baczewski, T. Kałdoński: Paliwa do silników o zapłonie samoczynnym; WKiŁ 2004
2. K. Baczewski, T. Kałdoński: Paliwa do silników o zapłonie iskrowym; WKiŁ 2004
3. K. M. Romaniszyn: Alternatywne zasilanie samochodów benzyną oraz gazami LPG i CNG; WNT Warszawa 2007
4. Z. Szlachta: Zasilanie silników wysokoprężnych paliwami rzepakowymi; WKiŁ Warszawa 2002
Additional
1. C. I. Bocheński: Biodiesel paliwo rolnicze; Wyd. SGGW Warszawa 2003
2. R. L. Bechtold: Alternative Fuels ? Transportation Fuels for Today and Tomorrow; Wyd. SAE International 2002
3. D. J. Holt: Alternative Diesel Fuels. Wyd. SAE International 2004
4. M. Kozak: Studium wpływu komponentów tlenowych oleju napędowego na emisję toksycznych składników spalin z silników o zapłonie samoczynnym; Wydawnictwo Politechniki Poznańskiej 2013
5. Scientific journal "Combustion Engines"

Breakdown of average student's workload

	Hours	ECTS
Total workload	90	4,00
Classes requiring direct contact with the teacher	27	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	3,00