COURSE DESCRIPTION CARD - SYLLABUS

Course name
ALTERNATIVE POWERTRAINS IN TRANSPORTATION

Course

Proposed by Discipline
Civil Engineering, Geodesy and Transport
Type of studies
Doctoral School
Form of study
full-time

Year/Semester
II/4, III/6
Course offered in
English
Requirements
elective

Number of hours

Lecture
4

Tutorials

Projects/seminars

Number of credit points

1

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

Prerequisites

Knowledge: student has basic general knowledge of mechanics, physics, chemistry, technical drawing, durability of materials and construction of components of internal combustion engine systems.

Skills: The student is able to integrate the obtained information, interpret it, draw conclusions, formulate and justify opinions, especially in the field of processes and phenomena taking place in internal combustion engines and electric motors, he or she demonstrates technical thinking, associating cause and effect compounds in mechanics, physics, chemistry.

Social competencies: Student is aware of the social and economic importance of energy consumption and understands the technical aspects and effects of internal combustion engine operation and shows independence in solving problems, acquiring and improving the acquired knowledge and skills.

Course objective

Classes are divided into two modules covering the complex issue of energy management in modern motor vehicle propulsion systems. The first module concerns learning the issues related to the operation of the internal combustion engine in a hybrid system. The second module covers the cooperation of the internal combustion engine with electric drive in alternative systems. The student will get acquainted with the energy balance of different types of alternate drives. The student will learn about energy storage systems in vehicles and how to manage their flow. The course also includes providing basic information on alternative fuels used in various transportation systems such as road, water and air, such as hydrogen.

Course-related learning outcomes

Knowledge

A PhD student who graduated from doctoral school knows and understands:

1) scientific research methodology in disciplines represented at the Doctoral School, [SzD_W03]
2) basic principles of knowledge transfer to the economic and social sphere as well as those of commercialization of results of scientific activities and know-how related to these results [SzD_W07]

Skills

A PhD student who graduated from doctoral school can:

1) critically analyze and assess scientific research results, work of experts and other creative activities together with their contribution into knowledge development, [SzD_U02]
2) transfer the results of scientific activity to the economic and social sphere, [SzD_U03]
3) share results of scientific activity also in a popular form, [SzD_U05]

Social competencies

A PhD student who graduated from doctoral school is ready to:

1) acknowledge the importance of knowledge in solving cognitive and practical problems, [SzD_K03]
2) initiate actions in the public interests, [SzD_K05].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

PQF code	Methods for verification of learning outcomes	Assessment criteria
W03, W07	Verification through test at the end of lecture class	Test
U02, U03, U05	Verification through test at the end of lecture class	Test
K03, K05	Verification through test at the end of lecture class	Test

Programme content

1. HV and EV safety.
2. Diagnostics of batteries used in alternative vehicles.
3. EV charging network infrastructure.
4. The established operating conditions of the internal combustion engine in alternative drive systems
5. Energy storage systems in vehicles
6. Energy balance of different types of drive systems
7. Regenerative braking systems
8. Ways of determining the battery charge level in alternative vehicles
9. Autonomy of alternative vehicles.

Course topics

- Alternative powertrains in means of transportation
- Generation, storage and use of energy in alternative vehicles

Teaching methods

Lecture with multimedia presentation.

Bibliography

Basic

1. Rychter T., Teodorczyk A.: Teoria silników spalinowych. WKiŁ, Warszawa 2005.
2. Kowalewicz A.: Podstawy procesów spalania. WNT. Warszawa 2000.

3. Wisłocki K.: Studium wykorzystania badań optycznych do analizy procesów wtrysku i spalania w silnikach o zapłonie samoczynnym. Wydawnictwo Politechniki Poznańskiej 2004.
4. Pielecha I.: Optyczne metody wtrysku i spalania benzyny. Wydawnictwo Politechniki Poznańskiej 2017.
5. Serdecki W. (red.): Badania silników spalinowych. Wyd.PP, 2012
6. Merkisz J. Pielecha I., Układy mechaniczne pojazdów hybrydowych, Wydawnictwo Politechniki Poznańskiej, Poznan 2015.
7. Merkisz J. Pielecha I., Układy mechaniczne pojazdów hybrydowych, Wydawnictwo Politechniki Poznańskiej, Poznan 2015.
8. Schmidt T. Pojazdy hybrydowe i elektryczne w praktyce warsztatowej, WKŁ, Warszawa 2020
9. Magazine: electric & hybrid vehicle technology international.

Additional

1. Andreas Wimmer, Josef Glaser. Indykowanie silnika. Warszawa 2004.
2. Niewiarowski K.: Tłokowe silniki spalinowe. WKiŁ, Warszawa 1983.
3. Kowalewicz A.: Systemy spalania szybkoobrotowych tłokowych silników spalinowych. WKiŁ. W-wa, 1980.
4. Kowalewicz A.: Tworzenie mieszanki i spalanie w silnikach o zapłonie iskrowym. WKiŁ. Warszawa, 1984.
5. Serdecki W. (red.): Badania układów silników spalinowych. Wyd.PP, 2000.
6. Pielecha I., Cieslik W. Thermodynamic analysis of indexes of operation of the engine with direct fuel injection for idle speed and acceleration. Journal of Thermal Analysis and Calorimetry. Mai 2016. doi: 10.1007/s10973-016-5544-
7. Pielecha I., Cieślik W., Merkisz J., Analysis of the electric drive mode use and energy flow in hybrid drives of SUVs in urban and extra-urban traffic conditions. Journal of Mechanical Science and Technology. 2019, 33(10); 5043-5050. DOI 10.1007/s12206-019-0943-4
8. Scientific articles in the field: SAE, MTZ, Combustion Engines.

Breakdown of average student's workload

	Hours	ECTS
Total workload	25	1,0
Classes requiring direct contact with the teacher	4	0
Doctoral student's own work (literature studies, preparation for tutorials, project preparation) [1]	21	1,0

[1] delete or add other activities as appropriate