



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Testing of hybrid and conventional powertrain systems [S2Elmob1-PAiME>BNHiK]

Course

Field of study

Electromobility

Year/Semester

1/2

Area of study (specialization)

Alternative Fuels and Energy Storage

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

30

Laboratory classes

15

Other

0

Tutorials

15

Projects/seminars

0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

KNOWLEDGE: the student has basic knowledge of conventional and hybrid propulsion systems, recognizes the elements of design and construction of components of propulsion systems. **SKILLS:** the student is able to integrate obtained information, interpret it, draw conclusions, formulate and justify opinions. **SOCIAL COMPETENCES:** the student is aware of non-technical aspects and consequences of the operation of internal combustion engines and their impact on the environment.

Course objective

To provide basic knowledge of diagnostics and the principle of operation of modern and future hybrid and electric systems applied in passenger vehicle powertrains.

Course-related learning outcomes

Knowledge:

Has advanced and in-depth knowledge of the design, diagnosis and operation of propulsion systems of

hybrid and electric vehicles including traction vehicles; knows the basic processes occurring in the life cycle of technical systems of hybrid and electric vehicles including traction vehicles (K2_W07)
Has a general knowledge of environmental problems associated with the implementation of selected chemical processes used in the recycling of materials and substances used in electromobility and the use of alternative fuels (K2_W09)
Has knowledge of development trends, new developments in the field of electromobility and the dilemmas of modern civilization especially in terms of the impact of changes in the ways of powering vehicles on the environment (K2_W10)
Has extended and deepened knowledge in the field of modeling, analysis and synthesis of elements and systems characteristic for hybrid and electric vehicles including traction vehicles (K2_W11)

Skills:

Can apply knowledge of the latest technical and technological developments in the design of non-standard devices and systems in the field of electromobility (K2_U01)
Is able, while formulating and solving complex and unusual engineering tasks and simple research problems, to apply the system approach and, using appropriate tools and apparatus, to make a critical analysis of the operation of simple and complex systems of hybrid and electric vehicles including traction, to evaluate them and propose their improvements (K2_U07)

Social competences:

Understands that in the field of technology, knowledge and skills devalue rapidly which requires their constant replenishment (K2_K01)
Is aware of the importance of the latest scientific and technical achievements in solving research and practical problems and, if necessary, to be supported by expert opinions (K2_K02)

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

For discussion and ongoing preparation and activity in lecture classes - written exam.
Mandatory individual reports from laboratories.
Mandatory individual reports from workshops.

Programme content

Basic knowledge of the diagnostics and operating principle of modern and future hybrid and electric drive systems applied to passenger vehicles. Analysis of actual vehicle operating conditions and the influence of the driving mode on the operation of the alternative propulsion system.

Course topics

- Exhaust after-treatment systems in modern powertrains by engine type and power system type,
- Directions of development of alternative propulsion systems in the aspect of environmental protection,
- The impact of the operation of machinery and vehicles with internal combustion engines on the emission of toxic compounds based on the preparation of characteristics of the share of operating time and emission histograms,
- Diagnostic systems for hybrid and electric vehicles,
- Diagnostics of batteries used in alternative vehicles,
- Analysis of energy consumption of the powertrain in real traffic conditions

Teaching methods

1. lecture with multimedia presentation
2. exercises with the use of software: Microsoft Office and AVL Concerto
3. laboratory

Bibliography

Basic:

1. Merkisz J., Pielecha I., Układy mechaniczne pojazdów hybrydowych. Wydawnictwo Politechniki Poznańskiej. Poznań 2015.

2. Merkisz J., Pielecha I., Układy elektryczne pojazdów hybrydowych. Wydawnictwo Politechniki Poznańskiej. Poznań 2015.
3. Merkisz J., Pielecha I.: Alternatywne napędy pojazdów. Wydawnictwo Politechniki Poznańskiej. Poznań 2006.
4. Torsten Schmidt Pojazdy hybrydowe i elektryczne w praktyce warsztatowej. WKŁ 2020.
5. Czerwiński A.: Akumulatory, baterie, ogniwa. WKiŁ, Warszawa 2005.
6. Szumanowski A.: Akumulacja energii w pojazdach, WKiŁ, Warszawa 1984.
7. Serdecki W. (red.): Badania silników spalinowych - Laboratorium. WPP, Poznań, 2012 lub późniejsze wydania.
8. Rokosch U., Kałużny J.: Układy oczyszczania spalin i pokładowe systemy diagnostyczne samochodów. WKŁ, 2016.
9. Merkisz J., Pielecha J., Radzimirski S.: Pragmatyczne podstawy ochrony powietrza atmosferycznego w transporcie drogowym. WPP, Poznań, 2009.

Additional:

1. Cieslik, W., Zawartowski, J., and Fuc, P., "The Impact of the Drive Mode of a Hybrid Drive System on the Share of Electric Mode in the RDC Test," SAE Technical Paper 2020-01-2249, 2020, doi:10.4271/2020-01-2249
2. Pielecha, I., Cieslik, W., and Szalek, A., "Impact of Combustion Engine Operating Conditions on Energy Flow in Hybrid Drives in RDC Tests," SAE Technical Paper 2020-01-2251, 2020, doi:10.4271/2020-01-2251
3. 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 [www]
3. Marek Brzeżański, Zdzisław Juda. BOSCH Napędy hybrydowe, ogniwa paliwowe i paliwa alternatywne. WKŁ 2010
4. Cieślik W. Alternatywne napędy jednostek pływających - przegląd. Biuletyn Techniki Jachtowej. 2019, 3/2019.
5. Pielecha I., Cieślik W., Szalek A. Energy recovery potential through regenerative braking for a hybrid electric vehicle in a urban conditions. IOP Conference Series: Earth and Environmental Science. 2019, 214, 012013, 1-10. DOI: 10.1088/1755-1315/214/1/012013
6. Fluder K., Pielecha I., Cieślik W. The impact of drive mode of a hybrid drive system on the energy flow indicators in the RDE test. Combustion Engines. 2018, 175(4), 18-25. doi:10.19206/CE-2018-403 [www]
7. Pielecha I., Cieślik W., Szalek A. Operation of electric hybrid drive systems in varied driving conditions. Eksploatacja i Niezawodność - Maintenance and Reliability. 2018, 20(1), 16-23.
8. Łukasz Rymaniak, Michalina Kamińska, Natalia Szymlet, Rafał Grzeszczyk. Analysis of Harmful Exhaust Gas Concentrations in Cloud behind a Vehicle with a Spark Ignition Engine. Energies - 2021, vol. 14, no. 6, s. 1769-1-1769-16
9. Conference and industry materials from engine manufacturers: Combustion Engines, MTZ, SAE.

Breakdown of average student's workload

	Hours	ECTS
Total workload	107	4,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	1,50