



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Hybrid powertrains

Course

Field of study

Mechanical and Automotive Engineering

Area of study (specialization)

Level of study

First-cycle studies

Form of study

part-time

Year/Semester

2/4

Profile of study

general academic

Course offered in

Polish

Requirements

compulsory

Number of hours

Lecture

9

Laboratory classes

9

Other (e.g. online)

0

Tutorials

9

Projects/seminars

0

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Faculty of Civil and Transport Engineering

Piotrowo 3 street, 60-965 Poznan

Responsible for the course/lecturer:

Prerequisites

KNOWLEDGE: the student has a basic knowledge of the design and construction of components and systems of hybrid drives

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 importance and understands the non-technical aspects and effects of transport activities



Course objective

Providing basic information on the construction and construction of hybrid drives in passenger vehicles, trucks and buses, taking into account the latest solutions

Course-related learning outcomes

Knowledge

Has knowledge in the field of physics, including the basics of classical mechanics, optics, electricity and magnetism, solid state physics, quantum and nuclear physics, necessary to understand specialist lectures in the field of the theory of construction materials and materials science, theory of machines and mechanisms, theory of electric drives and mechatronic systems.

Has basic knowledge of technical thermodynamics, ie the theory of thermodynamic changes, heat flow, thermal machines and heating, drying and cooling devices.

Has elementary knowledge of electric drives in machines, including three-phase current, AC and DC motors, frequency and voltage converters, power electronics.

Skills

Can obtain information from literature, the Internet, databases and other sources. Can integrate the obtained information, interpret and draw conclusions from it, and create and justify opinions.

Can use learned mathematical theories to create and analyze simple mathematical models of machines and their elements, and simple technical systems.

Can develop a manual and repair a simple machine from the group of machines covered by the selected certification path.

Can create a system diagram, select elements and perform basic calculations using ready-made computational packages of mechanical, hydrostatic, electric or hybrid machine drive system.

Social competences

Is ready to critically assess his knowledge and received content.

Is ready to recognize the importance of knowledge in solving cognitive and practical problems and to consult experts in case of difficulties in solving the problem on his own.

Is ready to fulfill social obligations and co-organize activities for the benefit of the social environment.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

For discussion, ongoing preparation and activity in class. Written credit. Mandatory individual reports from exercises and laboratories.

Programme content

Possibilities of using hybrid drives in means of transport. Division and characteristics of hybrid drives (series, parallel and mixed systems). Elements and structure of the drive train, examples of hybrid drive



structures in passenger cars, trucks and buses. Internal combustion and electric drive: connection methods and analysis of operating states. Examples of the construction of hybrid drives in various means of transport. Hybrid hydraulic drives, advantages, disadvantages, application possibilities. Hybrid drives with fuel cells. Emissivity of hybrid drives: their advantages and disadvantages. Development trends of hybrid drives.

Teaching methods

1. Lecture with multimedia presentation
2. Exercises - solving problems
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. Merkisz J., Pielecha I.: Alternatywne paliwa i układy napędowe pojazdów. Wydawnictwo Politechniki Poznańskiej, Poznań 2004.
5. Czerwiński A.: Akumulatory, baterie, ogniwa. WKiŁ, Warszawa 2005.
6. Szumanowski A.: Akumulacja energii w pojazdach, WKiŁ, Warszawa 1984.

Additional

1. Conference materials on hybrid drives
2. Combustion Engines quarterly
3. Pielecha I., Cieślik W., Szałek A. Operation of hybrid propulsion systems in conditions of increased supply voltage. *Int. J. Precis. Eng. Manuf.* (2017) 18: 1633-1639. doi.org/10.1007/s12541-017-0192-3
4. 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



Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	27	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) ¹	48	2,0

¹ delete or add other activities as appropriate