COURSE DESCRIPTION CARD - SYLLABUS

Course name
Traction drive systems [S1Elmob1>PO7-TUN]

Course

Field of study
Electromobility

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
30

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

The student has knowledge in the field of electrical engineering, electricity transmission, electrical machines, the basics of vehicle traffic theory, as well as the ability to work in a laboratory group.

Course objective

defining and systematizing the concepts of: transport, traction, traction energy distribution networks and presenting the legal principles of the operation of such networks, - presentation of technical and environmental requirements for drives used in vehicles, including requirements for energy storage in vehicles, - presentation of design solutions for modern drive systems used in vehicles powered from the distribution network, - presentation of drive systems and methods of controlling their operation depending on the current operating conditions and methods of energy supply to the vehicle, and the type of energy used, - acquisition of basic skills in the calculation of parameters of power systems and energy storage used in transport and the place of installation of these sources, - acquisition of basic skills in the field of testing selected drives.

Course-related learning outcomes

Knowledge:
Has an orderly and theoretically founded knowledge of the construction, principles of operation and operation of electric machines and drive systems used in electromobility; knows the principles and methods of diagnostics and the basics of reliability theory of technical systems appropriate for the field of study,
Knows and understands problems related to mass transport; is aware of the latest development trends related to the use of electricity in transport.

Skills:
He is able to consciously use modern technical solutions in the field of bulk transport, taking into account environmental, economic and legal conditions.
He can compare various technical solutions, assess them in terms of selected utility criteria.

Social competences:
He understands the need to formulate information and opinions on the positive and negative aspects of electromobility and is ready to act for the public interest.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
- assessment of knowledge and skills demonstrated during the written test.
Laboratory:
- knowledge test during laboratory exercises,
- assessment of student activity and assessment of the increase in knowledge, skills and social competences,
- evaluation of research reports.

Programme content

Basic terms, drives in the rail transport- control and power systems, development trends

Course topics

Lecture:
Definitions of terms: transport, traction. Breakdown of generally available means of transport. Classification of methods of powering vehicles powered by energy taken from the grid. Mobile sources of electricity, incl. fuel cells: construction, principles of operation, operation. Technical parameters and equipment of electric and pneumatic driven vehicles depending on the anticipated range of the vehicle. Drive units for rail vehicles - construction, control systems, power supply. Propulsion of vehicles powered from on-board sources - construction of modern high-performance asynchronous and synchronous traction motors. Methods of controlling the operating point of electric traction motors. Dynamic states in traction drive systems (starting, braking) - starting overcurrents. Traction characteristics. Influence of voltage on the running parameters of drives with motors: asynchronous and synchronous. Reluctance traction motors. Environmental exposure due to electromagnetic field emission by drives. Pneumatic and hybrid powered transport platforms. Pneumatic drive control. Drive systems in vertical transport (elevators) - structures, control methods and safety systems. Electric propulsion systems in water transport - main drives and auxiliary drives (bow thruster, capstan). Power and control systems. Optimization of vehicle traffic due to energy consumption. Energy management in vehicles. Effectiveness of regenerative braking in cooperation with energy storage.
Laboratory:
Research on power systems as well as energy conversion and conversion structures in electric vehicles intended for the bulk transport of passengers and goods with an urban or national range.
Model testing (simulation test) of a traction drive with an asynchronous and synchronous motor with permanent magnets.
Study of the operational properties of models of traction motors of various designs, powered from various sources.
Selection of the power source (charger) to the energy needs of the mobile energy storage.
Testing the model pneumatic transport platform.

Elevator drive test - modeling of the elevator control system.
Study of electromagnetic disturbances emitted to the environment by modern traction drive systems.

Teaching methods

Lecture with a multimedia presentation supplemented with examples on the blackboard, taking into account various aspects of the presented issues, including economic, ecological, legal and social.
Laboratory: discussions on the obtained research results, detailed review of reports by the lecturer, demonstrations.

Bibliography

Basic:
Szeląg A.: Trakcja elektryczna-podstawy, OWPW, Warszawa 2019
Skarpetowski G.: Przetworniki i przekształtniki energii w napędach trakcyjnych. Część 1 Przetworniki. Wydawnictwo „PIT" Kraków 2016
Dębowski A.: Elektryczny napęd trakcyjny. Wydawnictwo WNT 2019
Energetyka transportu zbiorowego. Praca zbiorowa pod redakcją Krzysztofa Karwowskiego. Wydawnictwo Politechniki Gdańskiej Gdańsk 2018
Towpik K.: Infrastruktura transportu szynowego. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2017
Steimel A.: Electric Traction-Motive Power and Energy Supply. Oldenbourg Industrievelag München 2008

Additional:
Krzysztof Karwowski i inni: Energetyka transportu zelektryfikowanego. Wydawnictwo Politechniki Gdańskiej. Gdańsk 2018.
Kacprzak J., Kozierkiewicz M.: Układy napędowe i sterowania trolejbusów. Monografia 28, Politechnika Radomska Radom str. 225.
Madej J.: Teoria ruchu pojazdów szynowych. OWPW 2012.
Rawicki S.: Energooszczędne przejazdy tramwajów ze sterowanymi wektorowo silnikami indukcyjnymi w dynamicznym ruchu miejskim Wyd. Politechniki Poznańskiej, Poznań 2013.
Szeląg A.: Wpływ napięcia w sieci trakcyjnej 3 kV DC na parametry energetyczno-trakcyjne zasilanych pojazdów. Instytut Naukowo-Wydawniczy SPATIUM, Radom 2013.
Jarzębowicz L., Kulig E.: Analiza energochłonności pojazdu elektrycznego w oparciu o dane z pokładowego rejestratora parametrów. TTS,nr 12/2015.
Pawełko P.: Napęd i sterowanie pneumatyczne podstawy, skrypt Wydawnictwo ZUT Szczecin 2013.
Świder J.: Sterowanie i automatyzacja procesów technologicznych i układów mechatronicznych, Wydawnictwo Politechniki Śląskiej, Gliwice 2006.

Breakdown of average student's workload

	Hours	ECTS
Total workload	83	3,00
Classes requiring direct contact with the teacher	45	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	38	1,50