COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electrical machines in electromobility [S1Elmob1>MEwE2]

Course

Field of study
Electromobility

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
45

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Knowledge of methods of electric and magnetic circuit analysis. Knowledge of methods of magnetic field and electromotive force generation. Acquirements of the construction and operation of transformers and induction machines. Basic knowledge of metrology. Ability to analysis of simple electric and magnetic circuits and determination of equivalent circuit parameters of the transformer and the induction motor. Ability to connect electric circuits and to measure of electric and mechanical quantities. Awareness of necessity of knowledge and acquirements extension. Ability to submission to rules standing during lectures and laboratory class. Ability to communicate with the teamwork during lectures and laboratory classes.

Course objective

Getting to know construction, principles of operation, characteristics, exploitation properties and basic methods of analysis of typical operation states of synchronous, commutator and special machines used in the motor drives of electric vehicles. Learning the fundamental methods of investigation and measurements of electrical machines.

Course-related learning outcomes

Knowledge:

1. have well-ordered and completed by theory knowledge of construction and fundamental analysis of synchronous, commutator and special electric machines in electromobility systems.
2. 2. have knowledge related to the principles of operation and measurements as well as identification of electrical machine parameters and characteristics with the particle emphasis on motor drives of electric vehicles.

Skills:
1. can identify parameters and determine characteristics of electrical machines, and use the known methods, mathematical models and computer simulations for analysis and estimation of electrical machines equivalent circuits.
2. plan and realize the measurements of basic parameters and characteristic of electrical machines in electromobility, as well as present the obtained results both in the numerical and graphical form; make interpretation and draw proper conclusions.

Social competences:
1.have awareness of importance and understanding of different aspects and results of technical activities, taking into consideration influence on environment; awareness of responsibility for decisions think and work by creative way within the new method of energy storage and conversion.
2. think and work by creative way within the electromobility.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lectures and tutorials:
- evaluation of knowledge and skills presented in the written exam,
- frequent appraisal during exercise classes (the awarding student activity).
Laboratory classes:
- test and awarding knowledge during realization of laboratory classes on electrical machines,
- evaluation of student activity and appraisal both of increase of his knowledge, skills and social competences connected withvactivities in teamwork,
- evaluation of knowledge and skills related to the individual laboratory class, appraisal of the report.

Programme content

Fundamentals of electromechanical energy conversion. Synchronous machines. Permanent magnet synchronous machines. Synchronous
Reluctance motors. Direct current (DC) machines. Brushless DC machines. Switched reluctance and switched flux machines, stepper motors. High-reliability multiphase motors adapted for electric vehicle propulsion.

Course topics

Lecture
Synchronous machines: construction and principle of operation, vector diagram, equivalent circuit, no-load and short-circuit of synchronous generator, steady-state characteristics, salient-pole machines, alternators. Permanent magnet machines: constructions of rotors (SPM vc IPM), damping windings. Reluctance motors. Direct-current commutator machines: construction and principle of operation, connection systems of windings, magnetic field in air-gap, armature reaction, commutation, compensating winding, motor characteristics, control of motor speed, selected transient states. Brushless direct-current machines. Stepper and flux switching motors. Multiphase high speed reliable motors for motor drives of electric vehicles.
Laboratory
Systems and laboratory stands for tests and measurements of electrical machines and transformers. Fundamental tests of electrical machines and transformers. Determination of parameters and characteristics of transformers and electrical machines (transformer, induction and DC motor, synchronous machine) on the ground of measurements. Analysis of measurement results.

Teaching methods

Lectures with multimedia presentations supported laboratory exercises.

Laboratory with analysis of measurement reports prepared by students and discussions related to the measurement stand and procedures.

Bibliography

Basic
1. A. M. Plamitzer, Maszyny Elektryczne, wyd. VII, WNT Warszawa, 1986.
2. W. Karwacki, Maszyny Elektryczne, Wyd. Pol. Wrocławskiej, Wrocław, 1994.
3. M. S. Sarma, Electric Machines, Steady-State Theory and Dynamic Performance, West Publishing Company, wyd. 2, 1996.
4. P. Staszewski, W. Urbański, Zagadnienia obliczeniowe w eksploatacji maszyn elektrycznych. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2009.
5. W. Przyborowski, G. Kamiński, Maszyny Elektryczne, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2014.
6. J. Gieras, Electrical Machines, Fundamentals of Electromechanical Energy Conversion, Taylor&Francis Inc, 2016.
7. G. Kamiński, W. Przyborowski, A. Biernat, J. Szczypior, Badania laboratoryjne maszyn elektrycznych, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2018.
Additional
1. W. Latek, Teoria Maszyn Elektrycznych, wyd. II, WNT Warszawa, 1987.
2. Praca zbiorowa, Poradnik Inżyniera Elektryka, Tom 2, wyd 3, WNT Warszawa 2009.

Breakdown of average student's workload

	Hours	ECTS
Total workload	127	5,00
Classes requiring direct contact with the teacher	77	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00