COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electrical machines [S2Elenerg1>ME]

Course

Field of study
Electrical Power Engineering

Year/Semester
1/1

Area of study (specialization)
Renewable Sources and Storage of Energy

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
15

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

none

Course objective

Learning of construction, principles of operation, characteristics, exploitation properties and basic methods of analysis of typical operation states of transformers and induction machines. Learning of basic methods of calculation of magnetic circuits in electromagnetic converters.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. Learning the fundamental methods of investigation and measurements of electrical machines.

Course-related learning outcomes

Knowledge:
1. Knowledge of:
1) operation of elements and electric, mechanical, analog and digital systems; knowledge of physical phenomena occurring in such systems;
2) analysis of operation of power electrical engineering systems;

3) mathematical description of physical, chemical and energetistic processes
2. Knowledge of mechanics, thermodynamics, fluid mechanics, electricity and magnetism, optics, nuclear physics, solid-state physics; knowledge necessary to understanding of physical phenomena in electric, energetistic, electronic elements and systems allowing for their surroundings
3. Well-ordered knowledge within electric, electronic and power engineering electronics circuits theory; knowledge of signals theory and method of signals conversion

Skills:
1. Elaborate documentation relating to realization of an engineering problem and prepare the text containing discussion of results of this problem realization
2. Compare design solutions of elements and electric circuits according to the given utilizable and economic criteria (for example: power consumption, operation rate, cost)
3. use properly chosen methods and devices making possible measurement of basic quantities characterizing elements and systems of power engineering

Social competences:
1. Have awareness of importance and understand non-technical aspects and results of activity of power electrical engineer; here also understand activity influence on environment and responsibility for the taken decisions
2. Have awareness of responsibility for the own work and willingness of submission to rules of work in team and bear responsibility for jointly realized problems

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:
- evaluation of knowledge and skills presented in the written exam,
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 with activities in teamwork,
- evaluation of knowledge and skills related to the individual laboratory class, appraisal of the report.
Obtainment of the additional points in connection with activity, in particular:
- preparation of answers on questions and problems given by the lecturer,
-- skill of co-operation in the teamwork in laboratory,
- annotations connected with improvement of didactic materials,
- care and aesthetics of reports and problems elaborations within own learning.

Programme content

Principles of electromagnetic energy conversion; selected operating states of transformers and electrical machines operating in the power system.

Course topics

Magnetic circuits. Transformers ? no-load state, equivalent circuit, transformer operation at load, three-phase transformers, parallel operation, selected transient states. The elements of electromagnetic energy conversion. Electrical machines: fundamental definitions: distributed windings, rotating magnetic fields, electromotive force induced by rotating magnetic fields, winding factors. Induction machines: construction and principle of operation, equivalent circuit, dependence of torque on rotational speed, machines with cage rotor, skin effect in bars, speed control. Starting and braking operation of induction machine. Single-phase induction motors. Induction generator. 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, synchronous machine operation in power network, machines with permanent magnets, starting of synchronous motors, damping windings, selected transient states. Stepper motors. Direct-current commutator machines: construction and principle of operation, connection systems of windings, magnetic field in air-gap, armature reaction, commutation, compensating winding, generator characteristics, motor characteristics, control of motor speed, selected transient states. Alternating-current commutator motors. Brushless direct-current machines. Servo-motors. Investigations

and measurements of electrical machines. Determination of parameters and characteristics of electrical machines on the ground of measurements.

Teaching methods

The teaching methods used:
lectures: - a lecture with a multimedia presentation (including drawings, photos, animations) supplemented with examples on the board, taking into account various aspects of the issues presented, including: economic, ecological, legal and social issues, presenting a new topic preceded by a reminder of related content , known to students from other subjects,
laboratory - discussions on obtained research results, detailed review of reports by the laboratory leader, demonstrations, teamwork

Bibliography

Basic:
1. Maszyny Elektryczne, W. Karwacki, Wyd. Pol. Wrocławskiej, Wrocław, 1993
2. Mikromaszyny elektryczne, Sochocki R., Ofic. Wyd. PW, Warszawa, 1996
3. Maszyny Elektryczne, A. M. Plamitzewyd. VII, WNT Warszawa, 1982
4. Electric Machines, Steady-State Theory and Dynamic Performance, M. S. Sarma, West Publishing Company, wyd. 2, 1994 i wyd. następne
5. Zagadnienia obliczeniowe w eksploatacji maszyn elektrycznych. P. Staszewski, W. Urbański, Oficyna Wydawnicza Pollitechniki Warszawskiej, Warszawa 2011
6. Maszyny Elektryczne, W. Przyborowski, G. Kamiński, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2014

Additional:
1. Teoria Maszyn Elektrycznych, W. Latek, wyd. II, WNT Warszawa, 1987
2. Poradnik Inżyniera Elektryka, Praca zbiorowa, Tom 1 i 2, wyd 3, WNT Warszawa 2013.

Breakdown of average student's workload

	Hours	ECTS
Total workload	142	5,00
Classes requiring direct contact with the teacher	42	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	100	3,50