EJ2223 Design of Electrical Machines 7.5 credits

Konstruktion av elektriska maskiner

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

The official course syllabus is valid from the Spring semester 2025 in accordance with the decision by the Head of School: J-2023-2206. Date of decision: 2023-09-22.

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Electrical Engineering

Specific prerequisites

- Knowledge in electromagnetic field theory, 6 higher education credits, equivalent completed course EI1320/EI1228 or completed items TENE and TENM in EI1220.
- Knowledge in electric machines and drive systems, 6 higher education credits, equivalent completed course EJ2201.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After passing the course, the student should be able to

- Use the theory of magnetomotive force (MMF) including MMF waves, to decide magnetic flux density, inductances and magnetic limitations of electric machines
- Analytically calculate stator and rotor resistance, magnetizing inductance and leakage inductance components for induction machines and equivalent parameters for permanent-magnet synchronous machines
- Use the finite element method (FEM) to calculate magnetic and electromechanical performance of induction machines and permanent-magnet synchronous machines
- Design an induction machine and a permanent-magnet synchronous machine for a given requirement of torque given requirements on energy efficiency and thermal limitations
- Extract FEM data to implement transient models of permanent-magnet synchronous machines that include magnetic saturation, magnetic cross-saturation and harmonics
- carry out FEM calculations to calculate the resulting temperature distribution in an electric machine for a given torque and speed

in order to be able to use Maxwell's equations and basic principles in thermodynamics to analyse and design electric machines.

Course contents

- Magnetic circuits and their application to electric machines.
- Theory of MMF waves (including harmonics) and how this is applied on electric machines
- Calculation of flux density by means of magnetic circuits.
- The equivalent circuit of the induction machine derived by means of the theory of MMF waves
- Losses in induction machines.
- Electromagnetic design principles of induction machines.
- Thermal dimensioning of induction machines.
- Equivalent circuit of the permanent-magnet synchronous machine derived by means of the theory of MMF waves
- Electromagnetic design principles of synchronous machines.
- The finite element method to solve magnetic problems.

Examination

- PROA - Project work, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- PROB - Project work, 3.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.