KE2170 Fuel Cell 6.0 credits

Bränslecellen

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

Establishment

Course syllabus for KE2170 valid from Spring 2016

Grading scale

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

Education cycle

Second cycle

Main field of study

Chemical Science and Engineering, Chemistry and Chemical Engineering

Specific prerequisites

Admission requirements for programme students at KTH:
At least 150 credits from grades 1, 2 and 3 of which at least 110 credits from years 1 and 2, and bachelor's work must be completed within a program of engineering or natural science programme.

Admission requirements for independent students:
150 **credits** in a program of engineering or natural science, or corresponding knowledge. Documented proficiency in English corresponding to English B.

The course is not open for students at the Degree Progr. in Engineering Chemistry

Language of instruction

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

Intended learning outcomes

The general goal of the course is to give you a broad background in fuel cells and fuel cell systems, and basic knowledge about the principle of the fuel cell and the built-up of the system around it.

After completed course you should in order to get grades D and E be able to:

- Explain how a fuel cell works and describe the main components and their function.
- Describe the different fuel cell types with respect to electrolyte and electrode materials, operating temperature, electrode reactions, and applications.
- Explain and implement the relation between cell voltage, power density and efficiency of the fuel cell.
- Calculate an equilibrium potential, and explain and implement the relation between electrode potential, over potential and cell voltage. Describe the different irreversible losses occuring in fuel cells.
- Determine the electric as well as the total efficiency for both the fuel cell and its system by using thermodynamic data.
- Describe the main components in a fuel cell system for production of power and heat, and explain how the different components work together.
- Describe frequently used power electronics in the fuel cell system and their most important properties.
- Describe the fuel alternatives for production of hydrogen in stationary as well as in mobile applications, and discuss their advantages and disadvantages when regarding production, storage and distribution.
- Explain the most important processes for hydrogen production and discuss the advantages and disadvantages of them.
- Solve, in a group, a given assignment, and in a written report and in an oral examination explain and discuss how the group assignment was solved.
  For higher grades (A-C) you should also be able to:
- Compare the advantages and disadvantages of different fuel cell types and from this suggest and motivate the choice of a certain fuel cell for a given application.
- Decide what system components (fuel reformer, fuel cell type, power converter etc) that are preferred for a given application, and schematically illustrate such a system.
- In the group assignment, discuss and talk over a very open-ended question related to the fuel cell technique. Your argumentation should be well grounded from a technical and scientific point of view.
- Discuss how fuel cells could be integrated in the society and in the existing energy system.

Course contents

In a future society fuel cells are expected to play an important role as energy converters in vehicles, portable electronics and for distributed heat- and power generation. In the course we will discuss:

• thermodynamics and kinetics of electrochemical reactions

• the design and operation of fuel cells

• components, design and thermodynamics of the whole fuel cell system

• fuels for fuel cells; their production, handling and reformation in fuel cell systems

• power electronics in fuel cell systems

Apart from lectures, tutorials are held in order to make it easier to understand the calculation directed parts of the course and also to give the students a practical experience of solving fuel cell related problems. Beside the teacher led activities there is also a compulsory group assignment, in which the students solve problems related to a fuel cell system for a given application. The group assignment is examined in a written report and in an oral exam.

Course literature

James Larminie, Andrew Dicks, ”Fuel Cell Systems Explained” 2nd edition, Wiley (2003)

Examination

• PRO2 - Project, 3.0 credits, grading scale: P, F

• TEN1 - Examination, 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.

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

Other requirements for final grade

Examination (TEN1; 3 credits)
Project work (PRO2; 3 credits)

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.