SH2772 Chemistry and Physics of Nuclear Fuels 8.0 credits

Chemistry and Physics of Nuclear Fuels

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

Establishment

The course syllabus is valid from Spring 2022 according to the school principal's decision: S-2022-0529 Decision date: 2022-02-24

Grading scale

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

Education cycle

Second cycle

Main field of study

Chemical Science and Engineering, Engineering Physics

Specific prerequisites

"Subatomär fysik 6 hp" or corresponding studies in radioactive decay and nuclear fission. It is further assumed that the students have some previous higher-level education in the fields of general, inorganic and physical chemistry. However, as it is to some extent possible to compensate by ambitious self-studies of the provided reading material, students will be admitted without a formal evaluation of their chemistry skills.

English B / English 6

Language of instruction

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

Intended learning outcomes

The thermal, mechanical and neutronic properties of nuclear fuels and associated materials are covered in most common textbooks and nuclear engineering courses. In contrast, the inorganic and physical chemistry of the fuel materials is often neglected or explained using rules of thumb that have proven useful for traditional reactor designs. With the ongoing development of new reactor types, unorthodox fuel materials, non-aqueous coolants and higher operating temperatures, it will be necessary to have proper understanding of the principles and mechanisms governing the changes in and reactions between materials under extreme conditions and in untested combinations. This course aims to bridge the gap between basic university-level chemistry and advanced treatises on some particular aspect of nuclear fuel chemistry.

On completion of the course, students should be able to estimate solubilities and migration of materials in ceramic and metallic fuels, evaluate their thermo-chemical properties, identify realistic production methods for advanced fuels, predict chemical reactions between different materials in the reactor core, select suitable combinations of fuel, cladding and coolant for use in novel reactor types, distinguish between several important forms of corrosion and evaluate the potential for their appearance, perform simple calculations of mechanical and thermal stress in fuel rods and the associated limits of reactor operation, identify the major safety issues that emerge with increasing burn-up, and calculate yields and purities in refining and reprocessing.

Course contents

General theory and its application on nuclear materials will be interleaved throughout the run of the course. Since the students may have varying need to refresh some concepts fundamental to the course, such as different nuclear reactor designs or general university chemistry, those parts will largely be in the form of self-studies. The lectures will center on how such knowledge can be complemented and extended to describe less common materials under extreme conditions and explain complex physico-chemical processes in the reactor core. The lectures will also detail the principles and methods for fuel manufacture and reprocessing.

Examination

- HEM1 - Home Exercise, 2.0 credits, grading scale: P, F
- SEMA - Seminars, 2.0 credits, grading scale: P, F
- TENB - Examination, 2.0 credits, grading scale: A, B, C, D, E, FX, F
- TENA - Examination, 2.0 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

Presentation in the form of a seminar
Written and/or oral examination
Active participate in all course meetings is meriting.

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.