SH2613 Generation IV Reactors 6.0 credits

Fjärde generationens reaktorer

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

Course syllabus for SH2613 valid from Spring 2020

Grading scale

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

Education cycle

Second cycle

Main field of study

Engineering Physics

Language of instruction

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

Intended learning outcomes

The production of commercial nuclear power today is dependent on the availability of U-235, the only fissile nuclide naturally present on earth. Once the easily accessible resources of U-235 become exhausted, a transition to reactors capable of breeding their own fissile fuel from U-238 may become economically feasible. Breeder reactors of "Generation IV"-design, would besides plutonium, also recycle minor actinides, in order to reduce the long-term radio-toxic inventory sent to geological repositories. Another Generation IV-objective is the operation at high temperature, leading to better conversion efficiency, thus compensating for the higher maintenance and fuel costs of these systems. After this course, you will be able to make design choices that makes Generation IV reactors sustainable, safe and reasonably economical. This objective is achieved if you show that you are able to

- Calculate and analyse reactor safety parameters in fast neutron reactors.
- Assess breeding performance for potential fuels and coolants
- Select structural materials that permit high burnup in fast neutron spectra.

An intrinsic objective of the course is to achieve skills necessary for working as a scientist or engineer. The main assignment is therefore formulated as a project/research task, which will be presented in the form of a conference paper.The objective is accomplished if you show that you are able to

- identify missing pieces of information necessary to complete the research task and independently find this information from external sources.
- assess and use contents of references,
- communicate with your colleagues and your teacher about progress and problems arising during research,
- orally as well as in writing present the outcome of your results in a scientific and pedagogic manner.

Passing the course typically means that you have attended 20 hours of meetings, and performed 140 hours of work in your office. Most effort is thus to be done out of class.

Course contents

1. Physics of breeding

2. Safety parameters in fast neutron systems

3. Liquid metal and gas coolants

4. Fuels for fast reactors

5. Radiation damage in fast neutron spectra

6. Core design

Specific prerequisites

At least 120 credits in engineering and natural sciences and knowledge of English B or equivalent.

Recommended Prerequisites: Completed course in reactor physics (eg SH2600) or equivalent knowledge.

Course literature

- Fast neutron Generation IV Reactors, J. Wallenius & S. Bortot.
- Computer code manuals
- Collection of scientific articles

Examination

- INL1 - Home assignments, 1.0 credits, grading scale: P, F
- PRO1 - Project report, 2.0 credits, grading scale: P, F
- SEM1 - Seminar, 1.0 credits, grading scale: P, F
- TEN1 - Oral exam, 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.

The examiner, in consultation with the KTH Disability Coordinator (Funka), decides on any adapted examination for students with documented permanent impairment. The examiner may grant another examination form for reexamination of single students.

Other requirements for final grade

To pass the course you should actively participate in all course meetings. In-between lecture meetings, the result of home assignments will be presented and discussed at special course meetings. If you cannot attend a meeting, report this in advance, and you will be given an extra written assignment to replace the meeting you missed.

1. Calculation of cross sections for different coolants.

2. Calculation of neutronic safety parameters.

3. Calculation of coolant, clad and fuel temperatures.

You are further required to have participated in writing and presenting a conference report with the title "Performance and safety of a Generation IV reactor with coolant A and fuel B". The research for the report will be done in groups. The paper is to be presented orally at one of the course meetings. The final examination constitutes of an individual oral exam with the teacher about the contents of the paper, lasting 30-60 minutes.

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.