KE2045 Chemical Reaction Engineering 7.5 credits

Kemisk reaktionsteknik

2020, P4, Master's Programme in Chemical Engineering for Energy and Environment

Course content and learning objectives

Course description

The course introduces students to chemical reaction engineering and reactor design. The aim is to give an enhanced understanding of the theory of chemical reactors and skill in formulation and analysis of mathematical models in chemical reaction engineering. The classroom problems and the computer laboratory exercises aim to establishing problem solving skills with and without computer aid.

Learning Objectives

After completing the course, the students should be able to:

- Identify and describe ideal reactors and their characteristics.
- Develop, mathematical expressions (models) to describe the behavior of chemical reactors and analyze how kinetics, mass transfer and heat transfer affect the performance of the reactors.
- Apply analytical and numerical methods to determine reactors' behavior and analyze the results.
- Size and design chemical reactors and optimize operating conditions
- Apply RTD (Residence Time Distribution) methods to diagnose non-ideal flows in reactors and calculate conversions.

Specific Prerequisites

This course requires basic knowledge of chemical reaction engineering as well as basics in mathematics and numerical methods. Preferably, all courses corresponding to the first three years (the Bachelor of Science) in the study programme Chemical Science and Engineering, KTH, should have been completed. KE1175 'Chemical Process Engineering', as well as courses in numerical Methods and basic programming (e.g. SF1524) should have been completed or corresponding knowledge attained.

Course main content

The course is based on the following learning modules:

Theory and problem solving

There are three sections in this part, ideal reactor models, heterogeneous systems and non-ideal reactors.

Home and classroom problems

In this course there are exercises in the form of home and classroom problems that are solved by groups of students. Some of those problems are linked to the computer laboratory exercises.

Computer laboratory exercises

Computer laboratory exercises are carried out in groups. By this, the students are to exercise the whole chain from a problem in chemical reaction engineering, formulating a mathematical problem, choosing numerical algorithms, calculation methods and computer software, and doing the computer calculations in the computer classroom.

The class problems and the computer laboratory exercises aim to enhance problem solving skills both with and without computer usage. For passing the course is it essential to participate in solving the problems.

Language of Instruction

The course is given in English

Detailed Scheme

The course comprises 16 hours of lectures and 14 hours of classroom problems. There are 3 home problems and 7classroom problems giving a partial grade that together with the written exam will determine your final grade. The 14 hours of exercises are used for solving classroom problems. There are also 6 hours for compulsory computer assignments and a final written exam.

Key concepts

Plug flow model; complete mixing model; micro- and macro- mixing; residence time distribution; diffusion, mass transfer limitations

Course literature and preparation

Course literature

H. Scott Fogler, "*Elements of Chemical Reaction Engineering*", 5th edition, Prentice Hall, Boston, Massachusetts, 2016

Additional material, quizzes/challenges may be found on Canvas. The quizzes will help you to summarize important aspects and test your level of understanding.

Study instructions

A complete study guide is uploaded on Canvas

Disability

If you have a disability, you can get support via:
https://www.kth.se/student/studentliv/funktionsnedsattning
Inform the course responsible

In addition, inform the course responsible if you have special needs and show the certificate

Examination

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

A	90-100
B	80-89
C	70-79
D	60-69
E	50-59
Fx	40-49
F	<39

Examination

- BER1 – Home and classroom problems, 3.0 credits, grading scale: P, F
- LAB1 – Laboratory work, 1.5 credits, grading scale: P, F
- TEN1– Written exam, 3.0 credits grading scale: P, F

Passing criteria:
Passed BER1, LAB1 and TEN1.

The final grade of the course is determined based on the following algorithm:
0.65*TEN1+0.3*BER1*+0.05*LAB1

Teachers

Efthymios Kantarelis (ekan@kth.se) Course Responsible
Daniel Harding (djha@kth.se) Examiner
Jacob Venuti Björkman (jacobvb@kth.se) Teaching Assistant

Examiner

Dan Harding (djha@kth.se)

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.

Grading Criteria

A	Easily solve advanced problems with a single or multiple reaction and analyze the results of ideal, non-ideal or heterogeneous reactors combining different analytical and numerical methods
B	Solve advanced problems in non-ideal and heterogeneous reactors
C	Solve problems in ideal and heterogeneous reactors
D	Solve simple problems with different reactor arrangements (e.g in series or in parallel)
E	Identify and describe the different reactor types and develop their mathematical models

Examinations details

Written examination covers all of the course's main content and examples of older exams are uploaded on the Canvas platform.
Based on recommendation from KTH's coordination 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 course is changed or discontinued

If the course is no longer given, the student has the opportunity to be examined for another two academic years.

Further information

Learning platform

Canvas is used as learning platform for this course

Offered by

CBH/Chemical Engineering

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