



# KE2070 Transport Phenomena, Advanced Course 7.5 credits

Transportprocesser, fortsättningskurs

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 KE2070 valid from Autumn 2019

## 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

## Language of instruction

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

## Intended learning outcomes

Transport phenomena deals with the exchange of mass, energy, and momentum between systems, which plays an important role in engineered and natural systems. The course provides a systematic analysis and fundamental understanding of transport phenomena and its mathematical description which builds the foundation of modern simulation software packages.

After passing the course the student will be able to:

- apply the shell balance approach to derive differential mass and heat balance equations in Cartesian, cylindrical, and spherical coordinates
- apply the generalized differential mass and heat balance equations and the Navier-Stokes equations to analyze transport problems
- analyze transport problems in simple geometries and derive analytically the concentration, temperature or velocity distribution
- analyze transport problems in complex geometries and calculate numerically the concentration, temperature, or velocity distribution using a simulation software
- apply the concept of transfer coefficients to describe mass and heat transfer across interfaces

## Course contents

The course is framed around the concept of transport equations that describe the distribution of concentration, temperature, and velocity in time and space. We will discuss how these equations can be derived for specific problems and in different coordinate systems. Various examples illustrating the use of transport equations are discussed, such as chemical and biological reactors, membrane separators, heat exchangers, cooling fins, and flows in pipes and channels. In addition, case studies that exemplify how software packages such as Comsol use transport equations to simulate coupled transport processes in complex geometries are analyzed and worked out in detail. Case studies deal with processes such as tubular reactors, absorption columns, fuel cells, and flows around heating elements. On the theoretical side, the course covers time-dependent diffusion, diffusion in concentrated systems, derivation of the Navier-Stokes equations, boundary layer theory, basics of turbulence, and multiphase flows. The concept of transfer coefficients and the use of Nusselt and Sherwood correlations is covered with examples and problems.

## Specific prerequisites

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 programme that includes: 75 university credits (hp) in chemistry or chemical engineering, 20 university credits (hp) in mathematics and 6 university credits (hp) in computer science or corresponding.

## Examination

- SEM1 - Assignments, 3.8 credits, grading scale: P, F
- TEN1 - Written exam, 3.7 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.