Course Specifications
Valid as from the academic year 2019-2020

Reaction Kinetics and Reactor Design (I002510)

Course

Specifications

Lecturers in academic year 2019-2020
Van der Meeren, Paul
LA24 lecturer-in-charge

Course offerings and teaching methods in academic year 2019-2020
A (semester 2) Dutch
seminar: coached exercises 7.5 h
seminar: practical PC room classes 25.0 h
lecture 17.5 h

Offered in the following programmes in 2019-2020

<table>
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<tr>
<th>Programme</th>
<th>crds</th>
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<tr>
<td>Bachelor of Science in Bioscience Engineering (main subject Chemistry and Food Technology)</td>
<td>5</td>
<td>A</td>
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<tr>
<td>Master of Science in Bioscience Engineering: Cell and Gene Biotechnology</td>
<td>5</td>
<td>A</td>
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<tr>
<td>Master of Science in Bioscience Engineering: Environmental Technology</td>
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Teaching languages
Dutch

Keywords
Reaction kinetics, residence time distribution, reactor design

Position of the course
This course aims to provide the student with a better understanding of various aspects of the rate of transformation processes, such as (bio)chemical reactions and thermal processes (e.g. sterilisation). It discusses unit operations that include changes in chemical structure and hence is complementary to 'proces engineering' where unit operations are discussed that do not change the chemical structure.

Contents
First of all, thermodynamics aspects, such as heat exchange and position of the equilibrium, are considered. In addition, different ways to numerically indicate transformation rates are discussed. Besides, the rate-determining factors are discussed. In addition to batch processes, continuous reactors are considered as well. In the latter case, the flow-through characteristics are of primary importance.

Part 1: Thermodynamic aspects
· thermochemistry
· calorimetry
· entropy change upon chemical reaction
· Gibbs free energy
· chemical equilibrium

Part 2: Kinetics
· vocabularium
· influence of concentration on reaction rate
· rate equations of simple and complex reactions
· homogenous and heterogenous catalysis
· reaction rate theories
· collision theory of Arrhenius and collision kinetics
· transition theory of Eyring and derived equations

Course size (nominal values; actual values may depend on programme)
Credits 5.0 Study time 150 h Contact hrs 50.0 h

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(Approved)
Part 3: Reactor design

- types of reactors (batch reactor, plug-flow reactor, CFSTR)
- residence time distribution in flow-through reactor
- mixing time versus residence time
- E- and F-curves
- concentration profiles in reactors:
  - physical aspect: wash-out behaviour
  - chemical aspect: (bio)chemical transformations
- heat transfer in reactors

Initial competences

Profound knowledge about thermodynamics.

Final competences

1. Numerical description of the rate of discontinuous and continuous transformation processes
2. Simulation of time-dependent behaviour of reactant and product concentrations
3. Elementary knowledge of flow through continuous reactors

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Guided self-study, lecture, seminar: coached exercises, seminar: practical PC room classes

Extra information on the teaching methods

Theory: oral presentations
Exercises: guided calculation and simulation exercises

Learning materials and price

Course material is available

References

Included in the lecturing material

Course content-related study coaching

The study coaching will be taken care of by the teaching assistants of the department.

Evaluation methods

end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period

Written examination, open book examination

Examination methods in case of periodic evaluation during the second examination period

Written examination, open book examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Theory: period aligned evaluation
Exercises: period aligned evaluation

Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner.

Theory: written (open book) examination
Exercises: written (open book) examination

Calculation of the examination mark

(Approved)