Course Package

Process Technology

Name module	Process Technology
Educational programme	MSc Chemical Engineering
Period	First semester (Quarter 1A + 1B)
Study load	30 ECTS
Coordinator	A.S. Elbersen - Grote

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<tr><th>Quarter 1A</th><th>Quarter 1B</th><th>Quarter 2A</th><th>Quarter 2B</th></tr>
<tr><td>Chemical Reaction Eng.
(3,5 EC; Brilman)</td><td rowspan="2">Advanced Molecular Separations
(5 EC; De Vos)</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>Programming in Eng.
(1,5 EC; Thornton)</td></tr>
<tr><td>Advanced Catalysis
(5 EC; Lefferts & Mul)</td><td>Cost Management and Engineering
(5 EC; Joosten)</td><td></td><td></td></tr>
<tr><td colspan="2">Advanced Chemical Reaction Engineering
(5 EC; Brilman & Kersten)</td><td rowspan="2"></td><td rowspan="2"></td></tr>
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(5 EC; Benes & Kemperman)</td></tr>
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Required preliminary knowledge: Equilibria, Physical Chemistry, Fluid Dynamics, Heat and Mass Transfer, Separation Technologies, chemical reaction engineering, basic knowledge of catalysis and kinetic.

Chemical Reaction Engineering
In this course a general introduction to chemical reactor engineering is given. First, the focus is on the description of model reactors, i.e. (semi)-batch reactors, continuously stirred tank reactors and plug flow reactors, focusing on reactant conversion and product selectivity. Subsequently, it is discussed how actual reactors can be described or approximated by making use of the residence time distribution to quantify the extent of mixing. Finally, heat effects are discussed.

Programming in Engineering
Computations are omnipresent in complex engineering problems in solid mechanics, fluid mechanics, civil and process engineering. Many problems are resolved with the aid of computers and dedicated programs today. Therefore, it is really important for an engineer to be familiar with computers and programming languages. In this course, you will learn how to translate problems into algorithms and how to implement the algorithm into a computer language. We will focus on implementation in two widely used programming languages: MATLAB and C++. No previous programming knowledge is required. You will learn how to write, compile, and execute small programs in each language. We teach you how to write structured reusable code (object-oriented programming in C++) and how to visualize your solutions (in MATLAB). Further, we teach

how to better understand, analyze, optimise, and debug code. The course consists of lectures as well as lots of practical exercises. The course is divided into two sections, C++ and MATLAB. At the end of each section, you will be asked to solve a final assignment (at home), and attend an oral exam. Please note it is possible to do only the C++ or MATLAB part as well (for 1.5 EC each), or to complete the course in self-study.

Advanced Catalysis
This course provides a profound description of catalysis as compared to, preparing students for performing research on catalytic materials, both in industry and academia, as well as for knowledge-based operation and troubleshooting of catalytic reactors. The following aspects will be discussed: Fundamentals of Catalysis, Catalyst Preparation, Catalytic reactors, and Catalysis by alternative stimuli.

Advanced Chemical Reaction Engineering
The course focusses on the processes of mass transfer with chemical reaction in multiphase reaction systems (gas-liquid, gas-solid, gas-liquid-solid etc.). The interaction between mass transfer and reaction kinetics is a central theme. At the end of the course one will be able to describe multiphase chemical reactors by using reactor models and fundamental mass and energy balances. With these one is able to calculate reactant conversion, selectivity and product yield, accounting for the effects of residence time distribution, mass transfer, homogeneous or heterogeneous reaction kinetics, equilibria and heat effects.

Multi-component Mass Transport
This course aims at understanding of mass transport in multi-component mixtures, based on a simplified version of the theory of Maxwell and Stefan. The main aim is for students to be able to understand the basic principles of diffusion in mixtures containing various different species, driven by a combination of different driving forces, and to apply this understanding in specific relevant chemical technology applications. Within the course a lot of attention is paid to contemplation and discussion, in order to consolidate the new knowledge and insights. Within this context, students are requested to give a lecture on one of the chapters in the book and to answer relevant case study, in which the multi-component characteristics of transport are evident. The case study involves the use, and stepwise extension, of an existing Matlab code, allowing the students to gradually and relatively independently simulate and study an eventually complex problem.

Advanced Molecular Separations
In Advanced Molecular Separations, separation technology is discussed starting from molecular properties up to full scale processes. The focus is on choosing a separation technology for given molecular properties, and the subsequent molecular design of more advanced separation technologies. For two separation technologies, fluid separations and membrane technology, the molecular design and separation process are treated in much greater detail, including a discussion on useful models to describe thermodynamics and mass transfer. The course will include two tests, one on fluid separations and one on barrier separations, but will also include two assignments on selecting the right separation technology for a given separation case.

Cost Management and Engineering
The course objective is to provide engineering students with the theoretical understanding and practical approaches as well as the tools and techniques for the economic and financial evaluation of stand-alone but also competing design solutions for processes, products, construction projects, services and the practical application of the approaches in more complex settings. Engineers must be able to model the economic impacts of their recommendations during the life cycle of a project (widely interpreted). The course will focus on monetary quantification, using different system boundaries and perspectives. Students are challenged to go out and gather information on real-life applications of cost management and engineering techniques.
The course will use lectures, individual and group assignments and self-study. The lectures will be a mix of instruction and working on exercises. The students will also do independent research on subjects strictly related to the course.

The modules are tentative and subject to change. Please check the website *regularly.*