Module	**Chemical Engineering & Process Intensification**
Code	MLS_S04
Degree Program	Master of Science in Life Sciences (MSLS)
Cluster	Chemistry
Specialization	Chemical Development and Production
ECTS Credits	4
Workload	120 h: Contact 56 lessons = 42 h; Self-study 78 h
Module Coordinator	**Name** Dr. Thierry Chappuis **Phone** +41 (0)26 429 67 14 **Email** thierry.chappuis@hefr.ch **Address** Haute école d’ingénierie et d’architecture de Fribourg, Bd de Pérolles 80, CH-1700 Fribourg
Lecturers	• Dr. Christophe Allemann, HEIA-FR • Dr. Thierry Ursenbacher, HEIA-FR • External lecturers
Entry Requirements	Bachelor of Science in Chemistry or in a related field including chemical engineering, chemical reaction engineering, chemical kinetics (at Bachelor level), basic functional knowledge of mathematical software package (Matlab, GNU Octave, Python, Berkeley Madonna or Mathematica).
Learning Outcomes and Competences	The objectives are to study and understand the operations and engineering aspects underlying process intensification, flow chemistry and the use of microreactors. The student will be able to: • List and evaluate the important strategies used to intensify chemical processes • Evaluate the feasibility of a chemical reaction in an intensified unit (e.g. a microreactor) • Know how to engineer a microreactor and how to implement heterogeneous catalysis in it • List and evaluate the possibilities of mixing reaction and separation in a single integrated processing unit.
Module Content	The module is structured as follows: • Introduction about process intensification and flow chemistry • Flow chemistry: examples and use cases • Engineering aspects underlying microreactors design • Fluidic aspects underlying microreactors design • Microreactor types, classification criteria for chemical reactions and technology choices (external lecturer) • Heterogeneous catalysis in microreactors

	• Integrated processes and ISPR • Integrated processes and reactive extraction • Integrated processes and membrane reactors • Integrated processes and reactive distillation • Process efficiency
Teaching / Learning Methods	• Lectures • Presentations of external lecturers from industry • Case studies • Active participation in the module is requested
Assessment of Learning Outcome	• Final examination (written): 100 % of the final grade • Reassessment: written exam
Bibliography	• W. Ehrfeld, V. Hessel & H. Lowe, Microreactors: new technology for modern chemistry, Wiley-VCH, Weinheim, 2004 • T. Wirth, Microreactors in organic chemistry and catalysis, , Wiley-VCH, Weinheim, 2013 • H.S. Fogler, Elements of chemical reaction engineering, 5th edition, Prentice Hall, Upper Saddle River, 2016 • F. Keil, Modeling of process intensification, Wiley-VCH, Weinheim, 2007 Documentation: http://cyberlearn.hes-so.ch (requires a login)
Language	English
Comments	
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