

# Master in Life Sciences

A cooperation between  
BFH, FHNW, HES-SO, ZHAW

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| <b>Module title</b>                      | <b>Chemistry and Energy</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Code</b>                              | C5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Degree Programme</b>                  | Master of Science in Life Sciences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Group</b>                             | Chemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Workload</b>                          | 3 ECTS (90 student working hours: 42 lessons contact = 32 h; 58 h self-study)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Module Coordinator</b>                | <b>Name:</b> Dr. Jürgen Stohner<br><b>Phone:</b> +41 (0)58 934 54 93<br><b>Email:</b> juergen.stohner@zhaw.ch<br><b>Address:</b> ZHAW Life Sciences and Facility Management, Einsiedlerstrasse 31, 8820 Wädenswil                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Lecturers</b>                         | <ul style="list-style-type: none"> <li>• Dr. Christian Adlhart, ZHAW</li> <li>• Dr. Thomas Pielhop, ZHAW</li> <li>• Dr. Dominik Brühwiler, ZHAW</li> <li>• Dr. Jürgen Stohner, ZHAW</li> <li>• Guest Lecturer</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Entry requirements</b>                | Basis knowledge in chemistry on the level of a BSc Degree in Chemistry is required; this includes knowledge in thermodynamics, electrochemistry, catalysis, inorganic and organic synthesis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Learning outcomes and competences</b> | After completing the module, students will be able to: <ul style="list-style-type: none"> <li>• understand the processes that lead from energy sources (solar, bio, chemical) to energy usage (e.g. mobility) considering               <ul style="list-style-type: none"> <li>- energy conversion</li> <li>- energy storage</li> <li>- energy distribution infrastructure</li> </ul> </li> <li>• evaluate the various energy sources with respect to energy density based on (bio)chemical foundations</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Module contents</b>                   | <p><u>Chemical energy storage</u></p> <p>Chemistry plays a crucial role in future energy storage strategies. Figures from the broad perspective of our current energy system including storage strategies (chemical, electro-chemical, mechanical and mobile) and energy storage densities will be given. These figures will be challenged in depth with the students' knowledge in thermodynamic and electrochemical concepts by selected examples including conversion and production technologies. These may include power to gas (thermochemical CO<sub>2</sub> activation), methanol chemistry, synthesis gas, hydrogen technology, ammonia, and mobile or static electrochemical storages systems such as redox flow batteries.</p> <p><u>Bio-gas/Bio-energy</u></p> <p>Biomass in its different forms (native – waste, lignocellulosic – carbohydrate – protein – lipid) represents an indispensable source of energy. This part will deal with different aspects of biomass characterization, treatment and energetic valorization such as:</p> <ul style="list-style-type: none"> <li>• methods to assess the sustainable potential of biomass of a region;</li> <li>• biomass composition and characterisation and the chemical value of biomass;</li> </ul> |

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|                                       | <ul style="list-style-type: none"> <li>the role, production and characterization of traditional bioenergy carriers (biogas, biomethane, biodiesel, bioethanol)</li> <li>the production and use of advanced biofuels (gasification, pyrolysis, synthetic biofuels) from renewable bioresources;</li> <li>advanced concepts of bioraffination of natural resources, including technology chains and energy products of biorefineries.</li> </ul> <p><u>Solar energy</u></p> <p>This part of the lecture focuses on two major fields of solar energy utilization, namely photocatalysis and photovoltaics. The following topics are covered:</p> <ul style="list-style-type: none"> <li>Photocatalysis: Generation of solar fuels (H<sub>2</sub> and products of CO<sub>2</sub> reduction) and environmental remediation (water purification).</li> <li>Photovoltaics: Theory of operation and chemistry of photovoltaics, including classic silicon-based and thin film cells, as well as emerging cell technologies and photon management.</li> </ul> <p><u>Energy and mobility</u></p> <p>This part highlights problems associated with 'mobility' when energy policy, air quality and climate issues are considered and which might be solved by the techniques discussed before.</p> <ul style="list-style-type: none"> <li>The turnaround in energy policy will lead us into the solar age, turning away from fossil fuels and nuclear power, with the following consequences:             <ul style="list-style-type: none"> <li>The greenhouse effect forces us to get rid of coal energy used for electric mobility.</li> <li>The political interest of air pollution control falls off, the climate debate has priority</li> <li>Biofuels and biomass combustion leads to conflicts of interests between air quality and climate when used for electric mobility</li> </ul> </li> <li>High density energy storage of renewable energy as a possibility</li> <li>Power to gas as an option for high density energy storage, using existing technology for storage, transportation and filling station</li> <li>Air pollutants and after-treatment of exhaust gases for the future mobility with diesel, petrol or electricity.</li> </ul> |
| <b>Teaching / learning methods</b>    | <ul style="list-style-type: none"> <li>Lectures</li> <li>short seminars</li> <li>presentations</li> <li>case studies</li> <li>exercises</li> <li>demonstrations and self-study</li> </ul> <p>When pre-readings and pre-course works are required, the students will be informed prior to the course.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Assessment of learning outcome</b> | 1. Final written examination (100%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Format</b>                         | 7-weeks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



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| <b>Timing of the module</b>   | Spring semester, CW 16-22                                                                                        |
| <b>Venue</b>                  | Blended learning format. Presence sequences take place in Olten                                                  |
| <b>Bibliography</b>           | Will be announced at beginning of the lectures. Course material can be downloaded from the MSLS Moodle platform. |
| <b>Language</b>               | English                                                                                                          |
| <b>Links to other modules</b> | -                                                                                                                |
| <b>Comments</b>               | -                                                                                                                |
| <b>Last Update</b>            | 22.09.2025                                                                                                       |

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