Module title	**Chemistry and Energy**
Code	C5
Degree Programme	Master of Science in Life Sciences
Group	Chemistry
Workload	3 ECTS (90 student working hours: 42 lessons contact = 32 h; 58 h self-study)
Module Coordinator	**Name**: Dr. Jürgen Stohner **Phone**: +41 (0)58 934 54 93 **Email**: juergen.stohner@zhaw.ch **Address**: ZHAW Life Sciences and Facility Management, Einsiedlerstrasse 31, 8820 Wädenswil
Lecturers	• Dr. Christian Adlhart, ZHAW • Dr. Urs Baier, ZHAW • Dr. Dominik Brühwiler, ZHAW • Dr. Peter Lienemann, ZHAW • Guest Lecturer
Entry requirements	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.

Learning outcomes and competences	After completing the module, students will be able to:
	• understand the processes that lead from energy sources (solar, bio, chemical) to energy usage (e.g. mobility) considering
	  - energy conversion
	  - energy storage
	  - energy distribution infrastructure
	• evaluate the various energy sources with respect to energy density based on (bio)chemical foundations

Module contents	<u>Chemical energy storage</u> 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 depths from the students' knowledge of thermodynamic and electrochemical concepts based on selected examples including conversion and production technologies. These may include power to gas (thermochemical CO_2 activation), methanol chemistry, synthesis gas, hydrogen technology, and mobile or static electrochemical storages systems such as redox flow batteries. <u>Bio-gas/Bio-energy</u> 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: • methods to assess the sustainable potential of biomass of a region; • biomass composition and characterisation and the chemical value of biomass;

	• the role, production and characterization of traditional bioenergy carriers (biogas, biomethane, biodiesel, bioethanol)
	• the production and use of advanced biofuels (gasification, pyrolysis, synthetic biofuels) from renewable bioresources;
	• advanced concepts of bioraffination of natural resources, including technology chains and energy products of biorefineries.
	
	<u>Solar energy</u>
	This part of the lecture focuses on two major fields of solar energy utilization, namely photocatalysis and photovoltaics. The following topics are covered:
	• Photocatalysis: Generation of solar fuels (H_2 and products of CO_2 reduction) and environmental remediation (water purification).
	• 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.
	
	<u>Energy and mobility</u>
	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.
	• The turnaround in energy policy will lead us into the solar age, turning away from fossil fuels and nuclear power, with the following consequences:
	  - The greenhouse effect forces us to get rid of coal energy used for electric mobility.
	  - The political interest of air pollution control falls off, the climate debate has priority
	  - Biofuels and biomass combustion leads to conflicts of interests between air quality and climate when used for electric mobility
	• High density energy storage of renewable energy as a possibility
	• Power to gas as an option for high density energy storage, using existing technology for storage, transportation and filling station
	• Air pollutants and after-treatment of exhaust gases for the future mobility with diesel, petrol or electricity.

Teaching / learning methods	• Lectures • short seminars • presentations • case studies • exercises • demonstrations and self-study When pre-readings and pre-course works are required, the students will be informed prior to the course.
Assessment of learning outcome	1. Final written examination (100%).
Format	7-weeks

Timing of the module	Spring semester, CW 15-21
Venue	Olten
Bibliography	Will be announced at beginning of the lectures. Course material can be downloaded from the MSLS Moodle platform.
Language	English
Links to other modules	
Comments	
Last Update	19.09.2019