UCLouvain

lmapr2147

2023

Sustainable Hydrogen Technologies

5.00 credits	30.0 h + 30.0 h	Q2

This biannual learning is being organized in 2023-2024

Teacher(s)	Filinchuk Yaroslav ;Proost Joris ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	Bachelor degree in Sciences or Engineering
Main themes	This course aims to provide students on a Master level in Sciences or Engineering with a basic training in all aspects of the hydrogen economy, not only from a technological perspective but also in a much broader economical and geopolitical context. It covers all aspects of the hydrogen value chain, including hydrogen production, use, storage & transport. Lectures will not only deal with specific materials- or chemistry related technical aspects, but also with markets, infrastructure and regulations. The course is made up of 4 different modules related to the above-described topics. Each module will have its own dedicated e-learning platform, including pre-recorded lectures, course materials, virtual laboratories, home work, and self-assessment quizzes. This platform will be implemented digitally and made available on-line, so that the course can also be followed and studied without the need to be physically present.
Learning outcomes	**At the end of this learning unit, the student is able to :** With respect to the Learning Outcomes (LO) of the program "Master in Chemical and Materials Engineering", this activity contributes to the development and acquisition of the following LO : • AA1.1, AA1.2 • AA2.3, AA2.6, AA2.7 • AA4.1, AA4.2, AA4.3 **Specific learning outcomes of the course** With respect to the disciplinary LO, the student at the end of the course will be able to : • have a clear insight into the technological challenges related to sustainable hydrogen production ; • identify the most suitable H2 production technology in function of its end use ; • understand the technological and infrastructural challenges related to the transport and storage of H2 ; • be aware of the economical and geopolitical drivers of the hydrogen economy. **Transversal Learning Outcomes** The course is also part of a European initiative on Innovation Capacity Building for Higher Education (project KICstartH2, entitled "*Accelerating Sustainable Hydrogen Uptake Through Innovation and Education*"). As a result, additional more transversal LO include the promotion of innovation and entrepreneurial skills amongst students, and fostering the transfer of knowledge related to sustainable hydrogen technologies between academia and industry.
Evaluation methods	For the coursework (vol. 1), the evaluation is either in written form or orally, to be determined every year depending on the number of students. Physical presence may be required for the evaluation of some specific modules. For the exercise part (vol. 2), a separate exam might be organized during the semester, the modalities of which will be communicated at the beginning of the course. The course evaluation may include continueous assignments outside the exam sessions, which will result in a single overall mark, communicated no later than before the June session. Failure to comply with the methodological instructions, particularly with regard to the use of online resources or collaboration between students, for any assignment will result in an overall mark of 0 for this continuous assessment.
Teaching methods	The course is based on lectures and exercise-based learning, offered partly in the form of classical in person lectures as well as inversed classes. The latter will be based on full **e-learning modules** (including pre-recorded lectures, course materials, virtual laboratories, home work, self-assessment quizzes) that will be implemented digitally and made available on-line, so that the course can be followed and studied without the need to be physically present. Based on its content itself, this course directly contributes to questions related to sustainable development, in particular with respect to the key role of hydrogen in the energy transition.
Content	**Module 1 : Sustainable hydrogen production**

	In a first module, an overview will be provided of all relevant hydrogen production technologies, with a specific emphasis on their sustainable character ("colours" of hydrogen). These include low- and high-temperature water electrolysis (green H2), photolysis (yellow H2), Steam Methane Reforming (SMR, grey and blue H2) and Methane pyrolysis (turquoise H2). Both chemical and materials related processing aspects of each technology will be included, as well as a more formal techno-economical comparison. **Module 2 : Sustainable hydrogen applications** In a follow-up module, the use of hydrogen will be discussed in 3 main sectors : transport, buildings and industry. A distinction will be made as to sustainable applications aiming to use H2 either as a chemical feedstock (e.g. for methanol and ammonia synthesis or as a chemical reductant in the glass and steel industry) or as an energy carrier (e.g. for combustion in fuel cells, engines or furnaces). **Module 3 : Hydrogen transport, storage & infrastructure** This module will cover all aspects of the hydrogen supply chain, from compression, transport & storage (incl. materials implications), to distribution, and use cases in specific industrial sectors or territories. **Module 4 : Hydrogen markets, geopolitics & regulations** This module will deal with market developments and regulatory frameworks, as an important basis for technical development, industrial employment, and public roll-out. Specific lectures will be dedicated to the implication of using hydrogen in vehicles, stationary and portable applications. Finally, an overview of hydrogen markets, market players, and future infrastructure developments will be given.
Inline resources	Moodle site LMAPR2147
Bibliography	Both a copy of the course slides as well as the class recordings will be made available to the students in the form of e-learning modules. The total contents of matter that is subject to examination is not limited to the course support, but includes everything that has been said or shown during the course, either orally, on screen or by other media.
Other infos	The course is part of the European project **KICstartH2**, entitled "*Accelerating Sustainable Hydrogen Uptake Through Innovation and Education*" and funded under the 2nd call for proposals of the European Institute of Innovation & Technology (EIT) Higher Education Institutions (HEI) Initiative on Innovation Capacity Building for Higher Education. From that perspective, one of the course objectives is also to promote innovation and entrepreneurial skills amongst students and foster the transfer of knowledge related to sustainable hydrogen technologies between academia and industry.
Faculty or entity in charge	FYKI

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemical and Materials Engineering	KIMA2M	5		