UCLouvain

lbir1381

2023

Principles of Biorefining

3.00 credits	30.0 h	Q1

Teacher(s)	Debecker Damien (coordinator) ;Stenuit Benoît ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Solid competencies in science and technology, for example accounting for a successful training in the bachelor (1st and 2nd year) in bio-science engineering, science, or civil engineering (in particular, general chemistry courses). Elementary bases in physics, microbiology, biology, organic chemistry, engineering (chemical and biological).
Main themes	Historical grounds for the development of biorefining, and current justifications, in the light of the environmental, climatic, and geopolitical context. Elements of sustainable chemistry and green chemistry (and the corresponding metrics). Production of useful products (fuels, chemicals, materials) from biomass: quantitative criteria (yield, reducing equivalents, etc.). Upstream processes for the harvest, storage, and pretreatment of biomass, before processing and transformation. Basic concepts for the transformation of biomass (reactors, chemical transformation, microbiological transformation, catalysis). Hydrolysis and fermentation of biomass resources. Downstream processing of bio-based molecules: separation, purification. Valorization as “drop in chemicals” or exploitation of the native functionalities of bio-based molecules. Examples of integrated biorefineries and mass balance at the process level.
Learning outcomes	**At the end of this learning unit, the student is able to :** a. Contribution de l'activité au référentiel AA LBIR1381 contributes to the learning outcomes B1.3, B1.6, B2.3, B4.2, B7.1, B7.3 b. Formulation spécifique pour cette activité des AA du programme At the end of the activity, the student is able of: B1.3, connaitre comprendre socle bioing B1.6, mobiliser savoirs multiples, comprendre probl multidisc B4.2, identifier concepts clés pour résoudre problématique B7.1, indépendance et regard critique B7.3, comprendre enjeux DD - enumerating and defining the different types of biomass, and the different chemical fractions of biomass 1 - understanding the working principles of biomass fractionation, transformation and upgrading, including the integrated concept of 'biorefinery' - stating and explaining the conceptual bases for the main purification techniques used in the context of biomass valorization - stating and explaining the conceptual bases for the main conversion processes used in the context of biomass valorization, including thermal, chemical, mechanical and catalytic transformation - discussing the complexity of the biorefinery concept and the interconnections between different streams - developing a critical thinking on the industrial, legal ethical and technological landscape of bio- vs. petro-sourced industries. The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled 'Programmes/courses offering this Teaching Unit'.
Evaluation methods	Written exam covering the learning outcomes as defined herein. (answers can be given in French)
Teaching methods	Ex cathedra course (30h), with power point slides used as a visual support (available beforehand via Moodle). References books and scientific articles are used as supports for the content. The course is taught in English. Some lectures may be taught in the remote mode.
Content	This teaching unit is a general introduction to the field of biomass valorisation, through the "biorefinery" concept. Due to the environmental concerns associated with the consumption of fossil resources, biomass appears as an attractive source for the production of fuels and chemicals. The course covers different aspects: • General introduction on the historical aspects around the “biorefinery” concept. Contextual analysis covering legal, ethical, economical aspects.

	• Definition of the different types and fractions of biomass; Discussion on storage, stability, and availability. • Technical bases for the transformation and conversion of biomass. Definition and description of the main concepts: reactors, catalysts, contact time, selectivity, yield, mass transfer, etc. • Description of the main biomass pre-treatments (mechanical, chemical, thermal). • Hydrolysis and fermentation: scientific basis and case studies. • Introduction to downstream processes for the separation and purification of the molecules of interest, and for their subsequent or combined valorization. • Upgrading (mainly catalytic upgrading) of bio-based platform chemicals for specific applications. • Examples of integrated biorefineries.
Inline resources	Moodle: https://moodleucl.uclouvain.be/enrol/index.php?id=12174
Bibliography	• "Biomass Processing, Conversion and Biorefinery", (2013) B. Zhang & Y. Wang, Nova Science Publishers, Inc., Ney York, pp 457 • "Biorefineries and Chemical Processes: Design, Integration and Sustainability Analysis", (2014) J. Sadhukhan, K.S. Ng, E. Martinez Hernandez, John Wiley & Sons, Ltd, pp613
Other infos	This course is taught in English.
Faculty or entity in charge	AGRO

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Development and Environment	MINDENV	3		
Master [120] in Environmental Bioengineering	BIRE2M	3		
Master [120] in Chemistry and Bioindustries	BIRC2M	3		