CU 7.2: CHEMICAL AND ENERGY VALUES

Director of studies: **Emmanuel FREDON**

General CU objectives:

• Describe and differentiate fractionation and conversion processes suitable for the production of fibrous materials (paper, cardboard, panels) or molecules (speciality lignin celluloses, biofuels, platform molecules, extractables).

• Identify the products of interest resulting from the chemical fractionation of wood biomass.

• Carry out conversion assessments and assess quantitative biomass needs with a view to obtaining a specific final product.

• Analyse a whole process, and know how to break it down into unit operations. Calculate material and energy flows.

• Discover and explain thermochemical pathways.

• Explain the operation of wood burning appliances.

• Discover and explain the new uses of wood as an energy source.

• Conduct a bibliographical study covering a field of application of chemical and energy recovery.

Consists of:

- Module 1: Chemical recovery
- Module 2: Energy recovery
- Module 3: Cross-cutting project
- Module 4: Not applicable

Hourly volume

In-person		*Self-directed study*
21.00 H	**Lectures**	**32.00 H**
36.00 H	**Tutorials**	
2.00 H	**Practicals**	

Positioning of the CU in the School reference system:

after CU 5.3, CU 6.2 and CU 6.3

Units of skills

In accordance with the RNCP sheet

Unit 1
Unit 4

Updated on 31 March 2025

CU 7.2: CHEMICAL AND ENERGY VALUES

Module 1: Chemical recovery	**Coefficient 1**
Session leaders: Emmanuel FREDON, Arnaud BESSERER, Pierre GIRODS	
Teaching assistants: Marie-Laure ANTOINE, Christelle PERRIN	
Prerequisites: CU 5.3 M1 and M3, CU 5.4 M1, CU 6.3	
Teaching materials: Presentation slides– Reading list– Arche Page– Project – Academic papers	
Assessment methods: individual and in groups Class assignment– Viva– experience reports– bibliographic report	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Describe and differentiate fractionation and conversion processes suitable for the production of fibrous materials (paper, cardboard, panels) or molecules (speciality lignin celluloses, biofuels, platform molecules, extractables). Identify the products of interest resulting from the chemical fractionation of wood biomass. Analyse and model a whole process, carry out simple material and energy balances, calculate yields.	Mechanical and thermochemical fractionation technologies for the production of particles, fibres and pulps. Industrial fractions: Cellulose pastes, black liquors and tall oil: their production and applications. Extraction processes, and application markets for extracts.	3.00		
	Pre-treatments and saccharification to obtain sugars and applications. Establishment of chemical balances, example of hydrolysis.	0.50	2.00	
	Biotechnological processes for deconstruction and conversion to molecules of interest. Introduction to enzymatic kinetics. Main micro-organisms used in bioprocess engineering.	1.75	2.00	
	Process engineering concept, general modelling of flows of material and energy, balances.		4.00	
	"From wood to bioethanol: pretreatments, saccharification, fermentation" demonstration of laboratory techniques and material balance calculations.			2.00
		5.25	**8.00**	**2.00**

CU 7.2: CHEMICAL AND ENERGY VALUES

Module 2: Energy recovery	**Coefficient 1**
Session leaders: Yann ROGAUME	
Teaching assistants: Access to documentation centre	
Prerequisites: CU 5.4 (combustion part)	
Teaching materials: Presentation slides– Reference book– Project	
Assessment methods: individual and in groups Class assignment– Viva– Report	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
The student must be able to: • Describe the main existing pathways • Give some context • Discuss ongoing developments • Illustrate the main pathways • Explain the differences • Choose a device according to the context of use • Describe the general operation of a combustion device • Describe the main systems • Provide examples, illustrate	General information on the different ways of recycling wood beyond its use as material – Role of these chemical and energy uses in the sector; – energy context: – biorefinery	1.75		
	General information on thermochemical pathways – pyrolysis - carbonisation – gasification– biofuels; – combustion.	5.25		
	Wood-burning appliances – general operation of appliances, general design principle; – differences between all systems for home heating; – the main industrial and collective systems.	5.25		
	Main ongoing developments – European and French context – heating networks – cogeneration	3.50		
		15.75	**0.00**	**0.00**

CU 7.2: CHEMICAL AND ENERGY VALUES

Module 3: Cross-cutting project	Coefficient 1
Session leaders: Yann ROGAUME	
Teaching assistants:	
Prerequisites:	
Teaching materials:	
Assessment methods: In groups bibliographical report produced in pairs	

Learning outcomes	Description	Number of student hours (in-person)		
		Lectures	Tutorials	Practicals
Monitor a field of application of chemical and energy recovery. Written report respecting a standard format for bibliographic references. Characterise developments of the system or process presented in the project	Based on an industrial project (apprentice's company, company's customers or provided by the school), this project will put into practice on a concrete example the skills acquired during this teaching unit. – Characterise product supply chains – Describe the general operation of the process studied and alternatives by explaining the differences between the systems		28.00	
		0.00	**28.00**	**0.00**