1A FISA	CU 5.3
Semester 5	7 School ECTS - 0 Company ECTS

CU 5.3: ANATOMICAL STRUCTURE AND PROPERTIES
STRUCTURE AND PROPERTIES OF WOOD

Director of studies: Romain REMOND

General CU objectives:

• Acquire basics of chemistry and biology

• Describe the training, functions in the tree and anatomy of different types of wood in relation to the properties of the material

• Recognise the most common softwoods and hardwoods, at microscopic and macroscopic levels

• Recognise the specific features of wood and understand the principle of wood classification

• Describe the chemical constituents of wood, their variability. Identify them by their representations, their properties, their proportion and distribution in the walls of the wood

• Establish correlations in relation to its physical properties

• Take into account all the anatomical, chemical and physical properties of wood to analyse/predict its transformations or possible interactions with an environment

Consists of:

- Module 1: Chemistry and Biology refresher course
- Module 2: Anatomical structures and properties
- Module 3: Chemical properties
- Module 4: Physical properties

Hourly volume

In-person	*Self-directed study*
33.25 H Lectures	**40.00 H**
42.00 H Tutorials	
0.00 H Practicals	

Positioning of the CU in the School reference system:

Semester 5 - M1 before CU 5.4

Units of skills

In accordance with the RNCP sheet

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Module 1: Chemistry and Biology refresher course	**Coefficient 3**
Session leaders: Marie Christine TROUY, Emmanuel FREDON	
Teaching assistants:	
Prerequisites: none	
Teaching materials: Course notes – Presentation slides – Exercises, reversed classroom pedagogy	
Assessment methods: individual Class assignment– Practical examination	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Understand the general functioning of a living being and a particular plant organism. Acquire a minimum foundation of knowledge in biology, a prerequisite for courses in wood anatomy (Module 2 of CU 5.3) and wood biodegradation (Module 1 of CU 6.2). Decode representations and nomenclatures, identify functions, types of bonds and translate them into chemical properties. Use molar quantities and stoichiometry in chemical equations and dilution calculations.	Biology: 1 – Chemistry, fundamentals of biology 2 – The plant cell 3 – Plant tissues 4 – The root system 5 – The laws of heredity (notions of genetics) 6 – Plant reproduction		6.00	
	Chemistry: 1 – Atoms and chemical bonds 2 – Nomenclature, chemical functions, polymers 3 – Handling of molar quantities 4 – Acid base and pH reaction 5 – Redox reaction		6.00	
		0.00	**12.00**	**0.00**

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Module 2: Anatomical structures and properties	**Coefficient 6**
Session leaders: Marie Christine TROUY, Arnaud BESSERER	
Teaching assistants:	
Prerequisites: CU 5.3 M1	
Teaching materials: Course notes – Presentation slides – Reading list – "Anatomy of Wood" SPOC on FUN	
Assessment methods: individual Class assignment– Tutorial note– Individual project note (document research)	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Describe the general operation of a tree to place wood formation and recycling back into the natural carbon cycle. Describe tree growth and wood formation. Describe the anatomy of softwoods and hardwoods. Recognise a wood species on a microscopic and macroscopic scale. Explain the links between anatomy and wood properties. Know the specific features to understand the principle of wood classification.	Anatomical structure: – Wood in the carbon cycle. – Tree growth and wood formation. – Cell differentiation and implementation of the different chemical constituents of the cell wall. – The different types of wood in a tree: sapwood, heartwood, duramen, juvenile wood, reaction wood. – Botanical classification and names of woods. – Anatomy and recognition of softwoods. – Anatomy and recognition of hardwoods. – Specific features of wood and the notion of classification.	21.00	20.00	
		21.00	**20.00**	**0.00**

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Module 3: Chemical properties	**Coefficient 4**
Session leaders: Emmanuel FREDON	
Teaching assistants:	
Prerequisites: CU 5.3 M1	
Teaching materials: Course notes – Presentation slides – Reading lists – Arche page	
Assessment methods: individual and in groups Class assignment	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Describe the chemical constituents of wood, identify them by their representations, their properties, their proportion and distribution in the cells. Distinguish parietal and extractable polymers, differentiate hardwoods and softwoods from a chemical composition point of view. Establish the correlations between the chemical structures of the constituents and the properties of the wood. Interpret experimental results, develop a critical mind towards a trial campaign, consult the bibliography to find answers.	Wood constituents: cellulose, lignin, hemicelluloses, extractables: descriptions, representations, biochemical classification and recognition of specific chemical functions, distribution in the walls. Role of constituents and properties (hydrophilic/lipophilic character, crystallinity, acidity, antioxidant properties, etc.). Major degradation reactions (acid hydrolysis, photo-oxidation). Methods for chemical modifications of wood. Design and implementation of a protocol highlighting the photochemical degradation of wood. Analysis of the results and critique of the protocols. Presentation in the form of a study report.	5.25	4.00	
		5.25	**4.00**	**0.00**

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Module 4: Physical properties	**Coefficient 4**
Session leaders: Romain RÉMOND, Éric MOUGEL	
Teaching assistants:	
Prerequisites: none	
Teaching materials: Course notes – Presentation slides	
Assessment methods: Individual Class assignment	

Learning outcomes	**Description**	**Number of student hours (in-person)**		
		Lectures	**Tutorials**	**Practicals**
Describe the hygroscopic behaviour of wood, evaluate its hygro-variations, and explain the distortions of lumber. Distinguish the different modes of moisture migration in wood. Explain the thermo-hygro-mechanical behaviour of wood and use it to shape it. Explain the effects of cell morphology and cell wall composition on basic physical properties of the material.	Wood density-porosity. Interactions between water and wood. The hygro-variations of wood. Migration of water in wood. Thermo-hygro-mechanical behaviour of wood.	7.00	6.00	
		7.00	**6.00**	**0.00**

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