1A FISE	CU 5.3
Semester 5	7 School 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**	**59.00 H**
22.00 H	**Tutorials**	
40.00 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 – Arche page - 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 organic chemical nomenclature, differentiate functions, types of bonds and translate them into chemical properties. Understand the notion of polarity of bonds and molecules. Use molar quantities and stoichiometry in chemical equations and dilution calculations. Master the concept of pH, the principles of acid/base reactions and redox.	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– Practical examination– Individual document search project	

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: – 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. – Observation of wood at the microscopic and macroscopic scale (species recognition).	21.00		20.00
		21.00	**0.00**	**20.00**

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Module 3: Chemical properties	**Coefficient 4**
Session leaders: Emmanuel FREDON	
Teaching assistants: Marie-Laure ANTOINE, Christelle PERRIN	
Prerequisites: CU 5.3 M1	
Teaching materials: Course notes – Presentation slides – Reading lists – Arche page	
Assessment methods: Individual Class assignment– Practical examination	

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. Apply simple protocols for characterising the chemical constituents of wood. Develop a critical mind towards a trial campaign. Search bibliographic data.	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 modification of wood. Practical work on the characterisation of wood constituents and properties, analysing experimental results and presenting them in the form of a study report. Design, implementation of a protocol to highlight the photochemical degradation of wood, analysis of the results and critique of the protocol.	5.25	4.00	8.00
		5.25	**4.00**	**8.00**

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Module 4: Physical properties	**Coefficient 4**
Session leaders: Romain RÉMOND, Éric MOUGEL	
Teaching assistants: Stéphane AUBERT	
Prerequisites: none	
Teaching materials: Course notes	
Assessment methods: Individual Class assignment– Viva– Practical examination	

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	12.00
		7.00	**6.00**	**12.00**

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