MASTER M2 BioWARE

BIOREFINERY ENGINEERING
OF WOOD AND AGRO-RESSOURCES

An original advanced M2 program, merging expertises of post-graduate engineering schools and laboratories of Université de Lorraine (Nancy, France)

COURSE CATALOGUE 2020-2021

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Website: ensaia.univ-lorraine.fr/fr/content/master-bioware
AGRO-BASED RESOURCES & WOOD : CHARACTERIZATION & MANAGEMENT

Unit Type: Compulsory

Proposed academic Supervisor: ECHEVARRIA Guillaume or PLANTUREUX Sylvain

LEARNING OUTCOMES

- To understand the main features of biomass, its main means of production and its outlets
- To evaluate the strengths and weakness of its use in a new repurposing sector
- To evaluate economical, ecological and social potential in its regional, national and international context

ORGANISATION

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UNIT DESCRIPTION

To understand the production of agro- and wood resources

To understand the main features of such renewable raw materials in order to get a comprehensive overview of the biorefinery sector and assess the sustainability of new production (for energy or bioproducts)

PREREQUISITS

Unit 938.1: no scientific prerequisite

Unit 938.2: Basic knowledge in biology, biochemistry, chemistry

SKILLS

Students are able to position agro- or wood recycling in its regional, national and international context and assess the economical, ecological and social potentials of the corresponding production sector.
BIOREFINERY: NEW TRENDS AND TECHNOLOGIES

Unit Type: COMPULSORY

Proposed academic Supervisor: Girods Pierre

LEARNING OUTCOMES
To be able to describe and analyse the biomass transformations ways with applications in: health, environment (phytomining), construction material, energy production.

To Analyse state of the art biorefinery processes and identify possible improvements and innovations.

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UNIT DESCRIPTION

Latest technologies for the production and recycling of agro- or wood fractions, using enzymatic or microbial conversion.

Illustrations of bioproduct use in a wide area of applications from energy, to biomolecules and bioproducts.

PREREQUISITS

Chemistry (main functions, organic reaction), microbiology (physiology and microorganisms’ classification), biochemistry (metabolic pathways, enzymatic reactions), thermodynamics, material science (composition and properties of materials)

Process Engineering to analyse transformations (balances, unit operations, kinetics).

SKILLS

In order to produce energy from a bio-sourced product, students are able:

- to propose the most suitable biomass type to increase its value
- to select the most suitable technology (chemical or biotechnological) and operating mode
- to assess costs and financial, environmental and social benefits of a given transformation
- get an overview of the various uses of the product obtained from a biorefinery
ADVANCED BIOPROCESSES

Unit Type: OPTION (Unit 941 or 942)
Proposed academic supervisor: DELAUNAY Stéphane

LEARNING OUTCOMES
To be able to lead a scientific approach to design a biological transformation for the recycling of agro-and wood resources.

It means design and define the optimal operating conditions of:
- microbial conversion processes
- enzymatic conversion processes
- transformation processes using animal or plant cells
- separation processes of bio-sourced products

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UNIT DESCRIPTION
New Research Trends in biotechnology and bioprocess engineering for the recycling of agro- and wood resources for the production of energy, biomolecules, bioproducts or biomaterials, with a focus on the current project activities in the research laboratories at Université de Lorraine.

PREREQUISITS
Biological systems (bacterial, yeast, fungi, animal cells, plant cell, enzymes)
Bioprocess engineering (balances, heat and mass transfer, kinetics).

SKILLS
Students are able to lead a scientific approach in order to solve a R&D challenge
- Design, scale-up and optimize an industrial bioprocess
- manage the complexity of biological process
- communicate scientific results
ADVANCED CHEMICAL PROCESSES

Unit Type: OPTION (Unit 941 or 942)
Proposed Academic supervisor: Cécile NOUVEL

LEARNING OUTCOMES

Students are able to:
- select the most suitable process for a given biomass type and a target bioproduct
- design, optimise and model thermal or chemical conversions, including reactor and downstream process scale-up...

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UNIT DESCRIPTION

Thermal and chemical processes for biomass conversion: Description and modelling of most of the recent technologies to produce energy or bio-sources, including pre-treatment of raw agro- and wood materials

PREREQUISITS

Chemistry, organic chemistry (main reaction and chemical functions)
Polymerization engineering (main polymerization mode and processes)
Chemical Engineering (ideal reactors, kinetics, transfer, heat and mass balances, RTD, unit operations, basics in process security)

SKILLS

To analyse and scale-up unit operations involved in the following thermal or chemical conversion of biomass:
- conversion of dry biomass to produce energy (Pyrolysis, Gasification, ...),
- Bioresource pre-treatments (steam explosion, organosol-kraft, chemical hydrolysis, L/S Extraction),
- Process for chemical modification (decomposition of lignin in sugar or polysaccharides),
- Polymerization process of bio-monomers and biopolymer characterization (polymerization, modelling, forming, extrusion...)
INTERDISCIPLINARY PROJET

Unit Type: COMPULSORY

Proposed academic supervisor: Frantz FOURNIER

LEARNING OUTCOMES

To be able to design and operate a chemical transformation for the recycling of agro- and wood resources for the production of bio-sourced energy, molecules, products or material while justifying the decision concerning: renewable raw material, technologies, transformation methods, sustainability.

This means:
(1) identifying the resources to be used to manage a scientific project,
(2) managing the work in a small team,
(3) developing a scientific approach,
(4) working in an experimental context, with methodical discipline and in safe conditions,
(5) summarising results in a written report and/or in an oral defence.

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UNIT DESCRIPTION

Interdisciplinary project related to biorefinery, in small groups to apply all the knowledge and skills acquired in modules 938, 939, 941 or 942

PREREQUISITS

Unit 938, 939, 941 or 942

SKILLS

Student are able to develop a scientific approach in order to solve a R&D challenge

- To design, scale-up and optimize an industrial process
- To manage the complexity of a chemical process
- To communicate scientific results.
LANGUAGES

Unit Type: OPTION (936 or 937)

Proposed academic Supervisor: Anik MORANDINI

LEARNING OUTCOMES

- For unit 936: A2 level (w.r.t. CECRL) in French
- For unit 937: C1 level (w.r.t. CECRL) in English

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UNIT DESCRIPTION

Unit 936: Initiation to the French language to allow non-French-speaking students to be more independent in day-to-day extra-curricular activities in a French-speaking environment

Unit 937: Advanced professional English, for fluent French speaking students only

PREREQUISITS

- Unit 936: none
- Unit 937: International certificate at B2 level in French (with respect to CECRL)

SKILLS

Unit 936: Be more independent in day-to-day life in a French-speaking extra-curricular environment

Unit 937: written and oral comprehension and expression for independent communication and professional use.