

## Environment

### Energy transition and circular economy: waste & biomass resources

#### IDENTIFICATION

CODE : GEN-5-S1-EC-EX-ETC  
ECTS : 5.0

#### HOURS

Lectures : 34.0 h  
Seminars : 0.0 h  
Laboratory : 0.0 h  
Project : 0.0 h  
Teacher-student  
contact : 34.0 h  
Personal work : 20.0 h  
Total : 54.0 h

#### ASSESSMENT METHOD

One final written exam without documents, comprising mainly multiple choice questions (MCQ) with possible additional questions of general understanding with free answers

#### TEACHING AIDS

Powerpoint-videos

#### TEACHING LANGUAGE

English

#### CONTACT

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#### AIMS

The depletion of natural resources (raw materials, fossil fuels, etc.) and the environmental and sanitary impacts related to their intensive exploitation makes it indispensable to develop the use of other alternative resources, such as biomass and waste.

This course aims to provide students with a global vision of the scientific and technical, regulatory and organizational approaches allowing to develop successfully these transitions. Its objective is thus to provide students with solid knowledge on biomass resources, their characteristics, their production and their mobilization, as well as on the production and treatment of waste aiming at their material and energy recovery.

#### CONTENT

The course is divided into 3 complementary units:

##### I- Unit 1: Waste (12 h):

- + waste treatment strategies based on the European hierarchy (recycling, material recovery, materials, agriculture, environment, disposal).
- + European regulatory context.
- + ETV (Environmental Technology Verification).
- + European waste catalog.
- + Dangerous and non-hazardous waste.
- + Discharge Directive.
- + Stabilization of waste-recovery in civil engineering.
- + Recycling of WEEE.
- + Biological treatment of organic waste: Composting, anaerobic digestion, bio-ethanol and hydrogen, general parameters to define the optimal operating conditions

##### II- Unit 2: Biomass (8 h):

- + Introduction and context: advantages, disadvantages, potentials, limitations, etc.
- + Biomass composition: basics of organic chemistry and biochemistry, structural nature of the main biopolymers.
- + Thermochemical treatments: combustion, pyrolysis, gasification.
- + Use of vegetal oils as biofuels: energy crops, treatments (transesterification, etc.).
- + Biological treatments (this part is included in unit 1).

##### III- Unit 3: Treatment of gases from biomass or waste (10 h):

Biogas (6 hrs): Expected learning outcomes

- + Know the characteristics of biogas.
- + Classify the main pollutants to be eliminated before the recovery of biogas.
- + Identify the appropriate treatment for the recovery of biogas in order to produce electricity or biomethane.

Gaseous effluents from thermal treatments and others (4 h):

- + dry process.
- + semi-wet process.
- + wet process.
- + condensation process.
- + NOX treatment (SCR and SNCR).
- + Dioxin treatment by adsorption.
- + Other treatments.

#### PRE-REQUISITE

Candidates should have completed the first year of a Science or Engineering-related degree programme.

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