COURSE DETAILS

BIOMASS THERMAL CONVERSION PROCESSES

DEGREE PROGRAMME: PRECISION LIVESTOCK FARMING

ACADEMIC YEAR 2025-2026

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE: BIOMASS VALORIZATION FOR ENERGY &COMMODITIES PRODUCTION AND GREENHOUSE GAS MITIGATION
MODULE: BIOMASS THERMAL CONVERSION PROCESSES
SSD OF THE MODULE: ICHI-01/C – TEORIA DELLO SVILUPPO DEI PROCESSI CHIMICI (EX ING-IND/26)
TEACHING LANGUAGE: ENGLISH
CHANNEL: //
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II, ANNUAL): II
CFU: 4

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None

PREREQUISITES (IF APPLICABLE)

None

LEARNING GOALS

The course aims at providing students with fundamentals sufficient for enabling them to evaluate the chief chemico-physical properties of biomass to select the proper pre-treatments and the adequate conversion technologies depending on feedstock properties, and for further understanding of biomass thermo-chemical processes.

Moroever, the student must be able to select unit operations to exploit waste/residue streams of the livestock farming according to the biotechnological routes. Basic concept of operation of selected units must be known.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The student needs to show ability to understand the fundamentals and technologies of biomass thermochemical conversion processes.

Applying knowledge and understanding

The student needs to show ability to understand/evaluate the chief chemico-physical properties of biomass and to select the proper pre-treatments. The student needs to show skills and competence in the selection of adequate conversion technologies depending on feedstock properties and customer request, and to participate in the management of conversion plants. In addition, the student needs to show autonomous ability to evaluate the performances of thermo chemical conversion units, and ability to collaborate in work groups and present solutions of assigned problems to the classroom.

COURSE CONTENT/SYLLABUS

FRONTAL LESSONS	HOURS
- Basics of heat and mass transfer processes for solid-, liquid- and gas-phase systems	**3**
- Notes on chemical reactions, reaction kinetics and reaction heats	**2**
- Chemical-physical properties of biomass. Characterization methods and analysis	**4**
- Introduction to the biomass thermo-chemical conversion processes	**3**
- Thermochemical routes to produce bioenergy, biofuels and biomaterials from biomass	**2**
- Biomass supply chain and main pre-treatments for thermochemical conversion: drying, screening, separation, densification, torrefaction	**2**
- Pyrolysis: fundamentals, primary reactions, secondary reactions, products, technologies, product applications, environmental and safety issues	**6**
- Slow and fast pyrolysis reactors	**6**
- Gasification: fundamentals and technologies, gas composition, gas cleaning and conditioning, gas applications, environmental impact, safety in plant management	**2**
- Combustion: fundamentals and technologies, safety and environment aspects	**2**
TOTAL	**32**

PRACTICAL TEACHING	HOURS
Methods and instruments for the characterization of the pyrolytic dynamics of biomass and biomass components: thermogravimetric analysis (TGA), differential scanning calorimetry (DSC)	**3**
Methods and software for the qualitative and quantitative analysis and interpretation of thermogravimetric curves for biomass devolatilization and combustion	**3**
Methods and instruments for the chemical characterization of pyrolysis gas and bio-oil: gas chromatography (GC), mass spectrometry (GC-MS), high performance liquid chromatography (HPLC)	**2**
TOTAL	**8**

READINGS/BIBLIOGRAPHY

D. L. Klass- Biomass for Renewable energy, fuels and chemicals. Academic Press 1998.
Lecture notes provided during the course.

TEACHING METHODS

Teacher will use: a) lectures for approx. 80% of total hours; b) practical exercises for approx. 20% of total hours.

The teacher will use a student-centered method; tutorials; Practical lessons, learning by doing method. The lessons will be supported by multimedia teaching material available to students on the teacher's website, after registering for the course.

EXAMINATION/EVALUATION CRITERIA

a) Exam type:

Exam type	
written and oral	
only written	X
only oral	
project discussion	
other	

In case of a written exam, questions refer to: (*)	**Multiple choice answers**	
	Open answers	X
	Numerical exercises	X

(*) multiple options are possible

b) Evaluation pattern:

The final mark will be weighted on CFU of each module and therefore will be made up of: Module BIOMASS THERMAL CONVERSION PROCESSES 4 CFU 44.4%; Module BIOCONVERSION PROCESSES 5CFU 55.6%.

For the evaluation, the “Regulation for Guidelines_for_exams_management” approved by the Didactic Coordination Committee of the Master Degree in Precision Livestock Farming will be considered.