

Course Unit	Biomass Systems		Field of study	Energy	
Master in	Renewable Energy and Energetic Efficiency		School	School of Technology and Management	
Academic Year	2023/2024	Year of study	1	Level	2-1
Type	Semestral	Semester	2	ECTS credits	6.0
Code	6793-475-1201-00-23				
Workload (hours)	162	Contact hours	T 30	TP 30	PL -
			TC -	S -	E -
			OT -	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) Arlindo Castro Ferreira Almeida, Hélder Teixeira Gomes, João Paulo Miranda Castro, Manuel Ângelo Rosa Rodrigues

### Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Recognize the biomass strategic and economic importance as an energetic resource.
2. Recognize the production systems of biomass for energy.
3. Identify the most important energetic products from biomass.
4. Identify the potential of the different sources of biomass for the valorisation of its energetic content.
5. Recognize the various synthesis processes of liquid biofuels and select the most adequate for the available biomass sources.

### Prerequisites

Before the course unit the learner is expected to be able to:  
Understand Thermodynamics and fundamentals of Chemistry.

### Course contents

1. Basic elements of biomass accumulation 2. Biomass production systems 3. Harvesting, transportation and storage 4. Conversion of solid biomass 5. Combustible gases from biomass 6. Fuel production from biomass 7. Advantages and environmental impact

### Course contents (extended version)

1. Basic elements of biomass accumulation
  - Biomass concept; Biomass as a solar energy store; EU Biomass Action Plan
2. Biomass production systems
  - Biomass from animal, forestry and agriculture exploitation systems residual products
  - Dedicated energy crops forestry and agriculture, Environmental Aspects. Crop Management. Microalgal.
3. Harvesting, transportation and storage
  - Herbaceous and ligneous material; Harvesting material; Drying methods; Compacting process
4. Conversion of solid biomass
  - Waste processing; bales, pellets; heat and electricity generation from biomass
5. Combustible gases from biomass
  - Fermentation, biogas
6. Fuel production from biomass
  - Introduction. Biofuel history. First, second and third biofuel generations.
  - Biomass gasification and Syn-Gas applications. Gasification chemistry.
  - Bio-Oil production. Bio-Oils by fast pyrolysis. Bio-Oils by liquefaction. Bio-Oil chemistry.
  - Triglyceride conversion. Transesterification. Pyrolysis and zeolite upgrading. Glycerol utilization.
  - Sugar conversion into fuels. Ethanol production. Biological hydrogen and methane production.
7. Advantages and environmental impact

### Recommended reading

1. Drapcho, C. , Nghiem, J. , Walker, T. ; Biofuels Engineering Process Technology, McGraw-Hill, New York (2008).
2. Huber, G. W. , Iborra, S. , Corma, A. ; Synthesis of Transportation Fuels from Biomass: Chemistry, Catalysts, and Engineering. Chem. Rev. , 106 (9), 2006, 4044-4098.
3. Camps, M. , Marcos, F. ; Los Biocombustibles, Ediciones Mundi-Prensa, Madrid (2008).
4. Tolosana, Eduardo; Manual técnico para el aprovechamiento y elaboración de biomasa forestal, Edic. Mundi-Prensa, Madrid (2009).
5. Damien, Alain; La Biomasa: fundamentos, tecnologías y aplicaciones, Edic. Mundi-Prensa, Madrid (2009).

### Teaching and learning methods

Theory: explanation of the theoretical concepts. Examples and case studies: presentation, discussion and analysis. Practice: Lectures to solve practical problems. Visits and applied field work

### Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary)
  - Practical Work - 50% (Practical component (mini tests, laboratory work, research or others))
  - Final Written Exam - 50% (Final exam accounts for 50% of the final grade)
2. Alternative 2 - (Student Worker) (Final, Supplementary, Special)
  - Final Written Exam - 100% (Exam includes the practical component)
3. Alternative 3 - (Regular) (Special)
  - Final Written Exam - 100% (Exam includes the practical component)

### Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation			
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20-03-2024	23-03-2024	23-03-2024	24-03-2024

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