INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Bioenergy Technologies			Field of study	Energy		
Bachelor in	Renewable Energy Engineering			School	School of Technology and Management		
Academic Year	2022/2023	Year of study	3	Level	1-3	ECTS credits	6.0
Type	Semestral	Semester	1	Code	9910-743-3103-00-22		

Workload (hours)	162	Contact hours	T 30	TP -	PL 30	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): Hélder Teixeira Gomes, Paulo Miguel Pereira de Brito

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. identify and characterize the biomass sources involved in the production of bioenergy (biodiesel, bioethanol, biomethane and electric energy)
2. recognize the importance of biomass in the sustainability and management of the energetic resources in the future
3. describe the chemical, biochemical and thermochemical principles involved in the conversion of biomass into the several bionergy forms
4. identify and explain the main technologies available to convert biomass into bioenergy
5. know the analytical methods and quality control parameters applied to biofuels for use in motorized vehicles
6. identify the trends and future research and development strategies to produce biofuels and to design biorefineries

Prerequisites

Before the course unit the learner is expected to be able to:
1. demonstrate strong knowledge on the fundamentals of basic sciences
2. demonstrate strong knowledge on the fundamentals of fluid mechanics and thermodynamics
3. demonstrate knowledge on the use of informatic tools in the resolution of engineering problems

Course contents

Biomass as resource for the production of bioenergy: chemical, biochemical and thermochemical principles. Characterization and availability. Fermentation and enzymatic processes for the production of biofuels. Chemical reactions for the production of biofuels. Thermochemical processes for the production of bioenergy: combustion, pyrolysis, liquefaction and gasification. Biorefineries. Case studies.

Course contents (extended version)

1. Biomass as resource for the production of bioenergy
   - Chemical principles
   - Biochemical principles
   - Thermochemical principles
   - Characterization and availability
2. Production of bioenergy
   - Chemical processes
   - Fermentation processes
   - Enzymatic processes
3. Thermochemical processes for the production of bioenergy
   - Combustion
   - Pyrolysis
   - Liquefaction
   - Gasification
4. Biorefineries
   - Types of bioenergies
   - Strategies for the future development of biorefineries
5. Case studies

Recommended reading

1. Donald Klass, Biomass for Renewable Energy and Chemicals, Academic Press, 1998.
2. Frank Calle (ed.), The Biomass Assessment Handbook: Bioenergy for a Sustainable Environment, Earthscan, 2007.
3. Caye Drapcho, John Nghiem, Terry Walker, Biofuels Engineering Process Technology, McGraw-Hill, 2007.
4. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill, 2007.
5. Gerhard Knothe, Jon Van Gerpen, Jürgen Krahl (eds.), The Biodiesel Handbook, AOCS Press, 2005.

Teaching and learning methods

Theoretical classes: exposition of concepts involved in bioenergy, discussion and presentation of examples. Practical classes: supervised resolution of application exercises and critical analysis of results. Laboratorial works involving the production of biofuels. Non-contact period: study of subjects and realization of research works on bionergy topics.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Case Studies - 15%
   - Laboratory Work - 25%
   - Intermediate Written Test - 30%
   - Final Written Exam - 30%
2. Alternative 2 - (Regular, Student Worker) (Supplementary)
   - Laboratory Work - 25%
   - Final Written Exam - 75%
3. Alternative 3 - (Regular, Student Worker) (Special)
   - Laboratory Work - 25%
   - Final Written Exam - 75%
4. Alternative 4 - (Student Worker) (Final, Supplementary, Special)
   - Laboratory Work - 25%
   - Final Written Exam - 75%

Language of instruction

Portuguese

Electronic validation

Hélder Teixeira Gomes, Paulo Miguel Pereira de Brito	Simão Pedro de Almeida Pinho	Ana Maria Alves Queiroz da Silva	Paulo Alexandre Vara Alves
14-10-2022	14-10-2022	18-10-2022	24-10-2022