INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Sustainable Technology in Chemical Engineering			Field of study	Chemical Enginnering Processes		
Master in	Chemical Engineering			School	School of Technology and Management		
Academic Year	2023/2024	Year of study	1	Level	2-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	6362-756-1205-00-23		

Workload (hours)	162	Contact hours	T	TP	PL	TC	S	E	OT	O
			-	-	60	-	-	-	-	-

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): Maria Filomena Filipe Barreiro, Mónia Andreia Rodrigues Martins

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Identify the principles of chemistry and green technology. Understand and interpret information sources in terms of environmental impact. Quantify sustainability metrics and associated costs.
2. Recognize the importance of raw material selection and solvent and catalyst selection strategies
3. Relate sustainable development and the availability of resources
4. Compare reaction and separation methods in the context of processes in sustainable engineering
5. Understand the opportunities and difficulties in the biorefinery concept.
6. Explain and compare the different forms of energy from renewable sources.
7. Carry out life cycle analysis and consequent selection of materials and products.
8. Apply the knowledge acquired to propose alternatives or new ways of production.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Apply and understand fundamental concepts on Chemical Engineering.
2. Apply and understand fundamental concepts on Chemical Processes Engineering.

Course contents

Introduction to Process Synthesis. Preliminary Steps for Process Synthesis. Heuristic Rules for Process Synthesis. Synthesis of Separation Sequences. Heat and Power Integration. Mass Integration.

Course contents (extended version)

1. Introduction
   - Definitions.
   - Information sources.
   - Sustainability and cost metrics.
2. Selection of Materials
   - Raw materials and renewable sources.
   - Green solvents: selection of ionic liquids, eutectic solvents, organic solvents.
   - Synthesis and selection of catalysts.
3. Reaction and Separation Processes
   - Reaction mechanism and reactor selection.
   - Separation methods.
   - Unit operations.
   - Closed, semi-continuous and continuous process.
4. Process Intensification
   - Technologies, techniques, and applications.
5. Biorefinery
   - Production of bioethanol, biodiesel by transesterification.
   - Hydrogen and methane.
   - Production of SynGas by biomass gasification.
   - Conversion of SynGas into hydrocarbons and post-processing.
   - Extraction of natural products.
   - Use of lignin and cellulose.
6. Life Cycle Analysis
   - Methodologies.
   - Decision making.
   - Continuous analysis.
7. Technology Assessment
   - Criteria, comparative analysis of processes, advantages, limitations, and commitments.

Recommended reading

1. Dicks, A. P. ; Hent A. (2015). Green Chemistry Metrics. A Guide to Determining and Evaluating Process Greenness. Springer.
2. Jimenez-Gonzalez, C. ; Constable, D. J. C. (2011). Green Chemistry and Engineering, A Practical Design Approach. Wiley.
3. Drapcho, C. M. ; Nghiêm; N. P. ; Walker, T. H. (2020). Biofuels Engineering Process Technology, McGraw-Hill.
4. Sonnemann, G. ; Tsang, M. ; Schuhmacher, M. (2019) Integrated Life-Cycle and Risk Assessment for Industrial Processes and Products. 2nd Edition.
5. Allen, D. T. ; Shonnard, D. G. (2001) Engineering: Environmentally Conscious Design of Chemical processes. Prentice Hall, Englewood Cliffs, 2001.

Teaching and learning methods

Presentation of fundamental concepts and tools for the understanding, application, and analysis of different themes. Detailed discussion either by presenting practical examples or solving exercises followed by a critical analysis. Additionally, projects will be carried out in a tutorial regime based on the proposal of processes based on sustainability.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
   - Projects - 50% (Problem solving and critical analysis.)
   - Final Written Exam - 50% (Final exam on all subject taught.)

Assessment methods

2. Alternative 2 - (Regular, Student Worker) (Supplementary, Special)
   - Final Written Exam - 100%

Language of instruction

English

Electronic validation

Maria Filomena Filipe Barreiro	Hélder Teixeira Gomes	Simão Pedro de Almeida Pinho	José Carlos Rufino Amaro
15-02-2024	13-03-2024	13-03-2024	16-03-2024