INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Process Analysis		Field of study	Physics and Chemistry	
Bachelor in	Industrial Management and Engineering		School	School of Technology and Management	
Academic Year	2023/2024	Year of study	1	Level	1-1	ECTS credits	6.0
Type	Semestral	Semester	2	Code	9104-754-1201-00-23	

Workload (hours)	162	Contact hours	T -	TP 60	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)	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. Analyze unit operations and design processes correspondent to different industrial sectors
2. Learn how to explore alternatives in the design of processes with impact in the following factors: maximization of products; minimization of sub-products, energy consumption e cost optimization
3. Perform mass and energy balances in unsteady and steady-state for different kinds of industrial processes and in the unit operations involved
4. Apply mathematical models based on mass and energy conservation laws to design and optimize industrial processes correspondent to different industrial sectors
5. Learn to do the economical evaluation of processes and generate alternatives

Prerequisites

Before the course unit the learner is expected to be able to:
None

Course contents

Design of processes. Unit operations and flux diagrams. Mass and energy balances. Unsteady and steady-state processes. Maximization of products; minimization of sub-products, energy consumption and cost optimization. Analytical and numerical solution of mathematical models. Economical evaluation of processes for optimization and profit maximization.

Course contents (extended version)

1. Process development. Unit operations and flux diagrams. Examples of industrial processes in:
    - biotechnology, food industry, chemical industry
    - pharmaceutical industry, automotive industry, etc.
2. Models derived from conservation laws and their mathematical analysis
    - Mass conservation principles
    - Energy conservation principles
    - Applications to process analysis and unit operations with definition of the systems boundaries
    - Steady state and transient state
    - Calculation techniques. Analytical approach and numerical approach
    - Application of the developed mathematical models for steady-state process analysis
3. Case studies in process analysis in different industrial sectors
    - Biotechnology
    - Food industry
    - Chemical industry
    - Pharmaceutical industry
    - Automotive industry
    - Other manufacturing industries
4. Economical evaluation of processes for optimization and profit maximization
    - Formulation of optimization problems
    - Objective function
    - Operation constraints
    - Resolution of optimization problems in EXCEL

Recommended reading

1. Process Oriented Analysis: Design and Optimization of Industrial Production Systems, U. B. Meyer, S. E. Creux, A. K. W. Marin, CRC Press, 2006.
2. Process Modelling and Model Analysis, I. T. Cameron, K. Hangos, Academic Press, 2001.
3. Industrial Chemical Process Analysis and Design, M. M. Martín, Elsevier, 2017.
4. Chemical Engineering Design and Analysis: An Introduction, T. Michael Duncan, Jeffrey A. Reimer, Cambridge University Press, 2nd edition, 2019.
5. Elementary Principles of Chemical Processes, R. M. Felder, R. W. Rousseau, John Wiley & Sons, 3rd edition, 2000.

Teaching and learning methods

Theory: Description of theoretical concepts. Analysis and discussion of application examples. Practice: Discussion of course materials, problems resolution in EXCEL, and discussion/analysis of homework assignments.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final)
    - Intermediate Written Test - 20% (Week 5)
    - Intermediate Written Test - 20% (Week 10)
    - Intermediate Written Test - 20% (Week 15)
    - Case Studies - 20% (Classroom tasks.)
    - Practical Work - 20% (Case-study.)
2. Alternative 2 - (Regular, Student Worker) (Final, Supplementary, Special)
    - Final Written Exam - 100%

Language of instruction

Portuguese, with additional English support for foreign students.

Electronic validation

Paulo Miguel Pereira de Brito	Hélder Teixeira Gomes	António Jorge da Silva Trindade Duarte	José Carlos Rufino Amaro
13-02-2024	13-03-2024	13-03-2024	16-03-2024