INSTITUTO POLITÉCNICO DE BRAGANÇA

Course Unit	Chemical Engineering Laboratory I			Field of study	Thermodynamics and Transport Phenomena		
Bachelor in	Chemical 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	9125-755-3103-00-22		

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): Ramiro José Espinheira Martins

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:
1. Remember basic concepts concerning heat transfer mechanisms, namely conduction, natural and forced convection and radiation.
2. Plan and develop experimental setups designed for the determination of convective coefficients and global heat transfer coefficients.
3. Recognize the importance of heat transfer equipments in the industrial processes context.
4. Plan and develop experimental protocols for the determination of physical and thermodynamic properties.
5. Determine experimentally solubility curves for binary systems.
6. Plan and develop experimental protocols for the determination of coligative properties like the crioscopic depression.
7. Determine experimentally the settling curve for a wastewater. Understand the coagulation /flocculation process and its environmental application.
8. Compare experimental data with theoretical results. Detect the need for critical experimental information and recognize and use the adequate sources to get it.

Prerequisites

Before the course unit the learner is expected to be able to:
1. Reveal knowledge acquired by the study of Engineering ground sciences.
2. Knowledge in the field of Physical Chemistry and Transport Phenomena.
3. Evidence experience in using computational tools.

Course contents

Execution of six of the following experimental protocols: Determination of heat transfer convective coefficients; Fluid heating in a agitated vessel; Study of a plate heat exchanger; Heat transfer by natural and forced convection around metallic cylinders; Crioscopic depression due to adition of a strong electrolyte and a non-electrolyte; Mutual solubilities in a binary liquid system; Unit operations (settling curve for a wastewater, color removal from an effluent - coagulation / flocculation).

Course contents (extended version)

1. Transport phenomena
   - Heat transfer, conduction and convection, heat exchangers
2. Colligative properties of solutions
   - Freezing point or cryoscopic depression of electrolytic and non-electrolytic solutions
3. Phase equilibria
   - Binary liquid-liquid systems
4. Unit operations (effluent treatment technologies)
   - Settling curve for a wastewater
   - Color removal from an effluent - coagulation / flocculation.

Recommended reading

1. Y. A. Çengel, Heat Transfer: a Practical Approach, 3rd edition, McGraw-Hill (2006)
2. F. P. Incropera, D. P. DeWitt, Fundamentals of Heat and Mass Transfer, 4th edition, John Wiley & Sons (2000)
3. E. G. de Azevedo, Termodinâmica Aplicada, 2ª edição, Escolar Editora (2000)
4. D. P. Shoemaker, C. W. Garland, J. W. Nibler, Experiments in Physical Chemistry, 6th edition, McGraw-Hill (1996)
5. Wastewater Engineering - treatment, disposal and reuse, 3rd Edition, (revised by Tchobanoglous and Franklin Burton) Metcalf and Eddy, Inc. , McGraw-Hill (1991)

Teaching and learning methods

The students prepare the experimental tasks based in the respective protocol, in order to access the objectives to be attained, the data that ought to be registered and the relevant questions to be addressed during the experimental session. The students may process the experimental data, namely more complex numerical procedures, during the presential classes.

Assessment methods

- Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
  - Reports and Guides - 9%
  - Laboratory Work - 51%
  - Work Discussion - 10%
  - Presentations - 10%
  - Final Written Exam - 20% (Minimum mark of 7 values.)

Language of instruction

English

Electronic validation

Ramiro José Espinheira Martins	Hélder Teixeira Gomes	Paulo Alexandre Vara Alves
05-10-2022	22-10-2022	04-11-2022