Course guide
820530 - QAQ - Analytical Chemistry

Last modified: 27/05/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: ANTONIO FLORIDO PEREZ

Others:

Primer quadrimestre:
ANTONIO FLORIDO PEREZ - Grup: M2
ORIOL GIBERT AGULLO - Grup: M2

Segon quadrimestre:
JOAN DE PABLO RIBAS - Grup: T20
ORIOL GIBERT AGULLO - Grup: T20

PRIOR SKILLS

Chemistry
Aqueous solution chemistry

REQUIREMENTS

QUÍMICA EN DISSOLUCIÓ AQUOSA - Prerequisit

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEQUI-19. Understand mass and energy balances, biotechnology, mass transfer, separation operations, chemical reaction engineering, the design of reactors, and the recovery and processing of raw materials and energy resources.

Transversal:
07 AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.
05 TEQ N1. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

TEACHING METHODOLOGY

The methodology consists on theoretic lessons where the teacher presents the learning objectives in relation to the contents of the subject. The contents are subsequently applied to solve practical problems. In these practical problems students are encouraged to actively participate. Real cases related to both industry and environment are also developed in order to learn choosing the adequate analytical techniques.
The adequate material and tools for the learning process are available for the students. The Digital Campus is also a web tool that is being used in order to give the students different material of the subject and in addition it is a tool to improve the communication between teachers and students.

LEARNING OBJECTIVES OF THE SUBJECT

The global objective of Analytical Chemistry is the students to learn the basic principles and applications (industrial and environmental) of the analytical chemistry, including classic and instrumental techniques.
At the end of the lessons, the students should be capable to:
1) Describe the scientific basis and most important applications of classic and instrumental techniques in analytical chemistry.
2) Distinguish the chemical needed pre-treatment of a sample before using any analytical technique.
3) Determine the concentration of any analyt in a sample by using titrating techniques.
4) Select the adequate analytical technique for the determination of the concentration of a solute in a sample.
5) Transform the signal of any instrumental technique in concentration units.

STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	40.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

-Tema 1. INTRODUCTION TO ANALYTICAL CHEMISTRY

Description:
Objectives of the analytical chemistry. Qualitative and quantitative analysis. Analytical methodologies (off-line, atline, in-line, at-time). The analytical problem. Chemical analytical reactions. Selectivity and sensibility. The samples and their pre-treatment. Avoiding interferences. Separation techniques. Evaluation of the analytical data and errors.

Full-or-part-time: 18h
Theory classes: 8h
Self study : 10h

-Tema 2. CLASSIC METHODS IN ANALYTICAL CHEMISTRY

Description:
- Introduction to titrations. Chemical reactions useful in titrations. Direct titrations and back titrations. Standard solutions. Determination of the equivalence point. Errors.
- Acid-base titrations: acidimetry and alkalimetry. Titrants. Primary Standard solutions. Titration curves. Titration of mixtures. Indicators. Errors.
- Complexometric titrations: Titration curves. Titrants, metalochromic indicators.
- Precipitation titrations: Titration curves, titrants and indicators.
- Redox titrations: Titration curves, redox titrants and indicators. Pre-treatment of the sample. Titrations with strong oxidants (permanganate and dichromate) and with strong reductants. Redox titrations with iodine.
- Industrial and environmental applications of titrations.

Full-or-part-time: 56h
Theory classes: 20h
Self study : 36h

-Tema 3. ELECTRONANALYTICAL METHODS

Description:
- Classification of electroanalytical techniques.
- Potentiometry: fundamentals. Types of electrodes. Instrumentation. Potentiometric titrations.
- Conductimetry: fundamentals, instrumentation and conductimetric titrations.
- Industrial and environmental applications of electroanalytical methods.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

-Tema 4. SPECTROSCOPIC METHODS

Description:
- Absorption and emission of light. Classification of the spectroscopic methods.
- Mollecular Absorption Spectroscopy UV-vis. Fundamental and instrumentation. Radiation sources, optics system and detectors. Qualitative and quantitative analysis. Lambert-Beer Law. Titrations.
- Atomic Absorption Spectroscopy. Fundamental and instrumentation. Atomization (fundamentals and techniques). Quantitative analysis.
- Fluorescence. Fundamentals and instrumentation. Qualitative and quantitative analysis
- Atomic emission. Fundamentals and instrumentation. The plasma. Quantitative analysis.
- Industrial and environmental applications of spectroscopic methods.

Full-or-part-time: 27h
Theory classes: 12h
Self study : 15h

-Tema 5. CHROMATOGRAPHY

Description:
- Fundamentals. Parameters of the columns. Classification.
- Gas-chromatography (GC). Instrumentation.
- Liquid-chromatography (HPLC). Instrumentation.
- Qualitative and quantitative analysis. Industrial and environmental applications.

Full-or-part-time: 24h
Theory classes: 10h
Self study : 14h

GRADING SYSTEM

Assessment qualification (NF):
NF = 0.20*EP1 + 0.20*EP2 + 0.30*EF1 + 0.3*EF2
where
1) EP1: Exam 1
2) EP2: Exam 2
3) EF1 and EF2: Final Exams
This subject has a re-evaluation test and the EEBE regulations will be applied. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

BIBLIOGRAPHY

Basic:
- Skoog, Douglas A. Fundamentos de química analítica. 8ª ed. Madrid, [etc.]: Thomson, cop. 2005. ISBN 8497323335.
- Harris, Daniel C. [et al.]. Anàlisi química quantitativa [on line]. Barcelona: Reverté, 2006 [Consultation: 04/03/2021]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6541. ISBN 8429172238.
- Christian, Gary D. Química analítica [on line]. 6ª ed. México [etc.]: McGraw-Hill, 2009 [Consultation: 29/04/2020]. Available on: http://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4367. ISBN 9781456219901.

Complementary:
- Harris, Daniel C. Exploring chemical analysis. 2nd ed. New York: Freeman and Company, cop. 2001. ISBN 0716735407.
- Kellner, Robert A. Analytical chemistry : the approved text to the FECS curriculum analytical chemistry. Weinheim [etc.]: Wiley-VCH, 1998. ISBN 3527288813.
- Skoog, Douglas A; Holler, F. James; Crouch, Stanley R. Principios de análisis instrumental. 6a ed. México: Cengage Learning, 2008. ISBN 9789706868299.
- Alegret, Salvador. Integrated analytical systems. Amsterdam [etc.]: Elsevier, 2003. ISBN 0444510370.

RESOURCES

Other resources:
The professors provide some support notes to the students as a study aid. Thus, the contents of these notes is:
- A collection of problems of each topic.
- Tables, graphs and figures.
- Articles, interesting Web pages, solved past papers, etc.

Furthermore, additional information about activity dates or examination grades are also given.