Course guide
330150 - AQ - Chemical Analysis

Last modified: 25/04/2024

Unit in charge: Manresa School of Engineering
Teaching unit: 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Compulsory subject).
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).

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

LECTURER

Coordinating lecturer: M. MONTSERRAT SOLÉ SARDANS

Others: CONCEPCIÓ LAO LUQUE

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Fundamental concepts of qualitative and quantitative analysis.
2. Know the concepts of volumetry, gravimetry and their applications in the analysis of matter.
3. Acquire basic knowledge of main instrumental analysis techniques.
4. Develop skills in laboratory work, so that the student is able to obtain reliable analytical data.
5. Ability to understand and apply the principles of basic knowledge of chemical analysis and its applications to the analysis of matter.

Transversal:
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
7. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.
8. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
9. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

Explanatory classes, in large groups, in which the concepts related to most of the specific objectives of chemical analysis will be discussed. The active participation of the student body will be encouraged in class in various ways: invite students to highlight the most relevant points discussed in class. In the small group classes, some time will be spent correcting, commenting on or solving problems in class. Solve the doubts that have arisen. For each of the 2 contents, problems or exercises related to the specific objectives of the content will be proposed, which will be part of the continuous evaluation (assessable problem / exercise).

The practices will be experienced in the chemical analysis laboratory, and will generally consist of three parts: (i) Pre-laboratory: according to practice, the student can document, review theoretical concepts, read a script or answer questions. (ii) Laboratory, mostly experimental, in which you will often have to obtain results, check or deduce properties of chemical compounds, learn to manipulate the apparatus and use the material of the chemical laboratory, working with method. The teacher will monitor the work carried out by the student in the chemistry laboratory. (iii) Post-laboratory: the student will have to prepare a report or poster. In some session, debate will be promoted among the group of students with the aim of creating learning situations (analysis, discussion, synthesis), improving communication skills while providing more effective feedback than that obtained with only the delivery of the report.

LEARNING OBJECTIVES OF THE SUBJECT

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STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	10.00
Hours large group	45,0	30.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. INTRODUCTION TO CHEMICAL ANALYSIS. VOLUMETRIC AND GRAVIMETRIC METHODS OF ANALYSIS

Description:
Fundamental concepts of qualitative and quantitative analysis.

Analytical process. Definition and stages. Previous operations: sampling and sample treatment. Signal measurement. Acquisition and processing of data.

Fundamental concepts of volumetric methods of analysis. Standard solutions and primary standards. Classification of volumetric methods. Calculation in volumes.
Acid-base volumetries. General considerations. Acid and base titration curves Acid-base indicators. Titrant reagents and primary standards. Acid-base indicators. Applications.

Complex formation volumetry. General considerations. Titration curves. Metallochromic indicators. Types of titrations with EDTA. Applications.
REDOX volumetric. General considerations. Indicators. Main titrant reagents. Applications.

Precipitation volumes. Titration curves. Indicators. Titrant reagents and primary standards. Applications.

Gravimetric methods of analysis. Fundamental concepts. Type of gravimetries. Applications and calculations.

Related activities:
- Laboratory practices 1, 2, 3 and 4 (small group).
- Lectures with active participation of students (large group).
- Problem solving and exercises in class (large and small group).
- Individual test (these contents will be part of activity 2).

Full-or-part-time: 75h
Theory classes: 23h
Laboratory classes: 7h
Self study : 45h

(ENG) 2. MÈTODES INSTRUMENTALS D'ANÀLISI

Description:
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Related activities:
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Full-or-part-time: 75h
Theory classes: 22h
Laboratory classes: 8h
Self study : 45h

ACTIVITIES

1. LABORATORY PRACTICES

Description:
PRACTICE 1. Acid-base volumetry.
PRACTICE 2. REDOX Volumetry
PRACTICE 3. Gravimetry: Determination of the hydration water of a salt. Determination of the percentage of lead in a sample.
PRACTICE 4. Handling of the sample. Determination of the fat of a food.
PRACTICE 5. Determination of sodium and potassium by flame photometry.
PRACTICE 6. Determination of copper in an alloy by AAS
PRACTICE 7. UV-VIS practice.
PRACTICE 8. Identification of substances by IR spectroscopy

Specific objectives:
At the end of this activity, the student must be able to:
- Determine the concentration of a substance in a volumetric sample.
- Carry out a gravimetry correctly.- Conèixer els sistemes de quantificació en anàlisi istrumental
- Know the quantification systems in instrumental analysis
- Determine the concentration of different sample analytes in different matrices by Atomic Absorption, Flame Photometry, UV-Vis and IR techniques.
- Extract the information generated by the analysis carried out, data processing and calculations of analyte concentrations.
- Present the results correctly in writing.

Material:
Laboratory material, reagents and instruments.
Athena digital campus.

Delivery:
Monitoring of work in the laboratory by the teacher.
Practice test.

Full-or-part-time: 40h
Self study: 25h
Laboratory classes: 15h

2. INDIVIDUAL EVALUATION TESTS

Description:
Two individual tests in the class with a part of theoretical concepts and resolution of problems and / or questions related to the contents of the subject.
- Test 1. Contents 1
- Test 2. Contents 2

Specific objectives:
The evaluation process must allow:
- Provide the indicators to monitor the learning achieved by the student.
- Encourage the effective contribution of the student in cooperative work, due to the fact that in addition to giving a group response, it must also be given individually.
- Acquire a global vision of the contents and the applicability of ANALYTICAL chemistry.
- Identify their gaps to improve their learning.

Material:
Statements and calculator to carry out the tests.

Delivery:
Resolution of the evidence and presentation in writing.

Full-or-part-time: 51h
Self study: 45h
Theory classes: 6h

GRADING SYSTEM

The final grade is obtained by applying the following percentages:
Laboratory practices (evaluable activity 1) 30%
Individual tests 1 and 2 (evaluable activity 2) 70%
Students who have not passed the subject by continuous assessment may take a final exam of the contents. Students who have done them but have not passed them may also make up the practices. The percentages of this final evaluation will be 70% for the content test and 30% for the practice test.

EXAMINATION RULES.

Required attendance in small group sessions (chemistry lab).
- Solve and deliver the two individual continuous assessment tests.

BIBLIOGRAPHY

Basic:
- Harris, Daniel C. Análisis químico cuantitativo [on line]. 3ª ed. Barcelona: Reverté, 2006 [Consultation: 08/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7708. ISBN 8429172246.
- Christian, Gary D. Química analítica [on line]. 6ª ed. México: Limusa, 2009 [Consultation: 03/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4367. ISBN 9789701072349.
- Rubinson, Kenneth A.; Rubinson, Judith F. Análisis instrumental. Madrid: Prentice Hall, 2001. ISBN 8420529885.
- Skoog, Douglas A.; West, Donald M.; Holler, F. James. Fundamentos de química analítica [on line]. 4a ed. Barcelona: Reverté, 1996-1997 [Consultation: 10/06/2022]. Available on: https://search-ebscohost-com.recursos.biblioteca.upc.edu/login.aspx?direct=true&AuthType=ip,uid&db=nlebk&AN=2931516&site=ehost-live&ebv=EB&ppid=pp_Cover. ISBN 8429175563.
- Skoog, Douglas A; Holler, F. James; Crouch, Stanley R. Principios de análisis instrumental. Séptima edición. México: Cengage Learning, 2018. ISBN 9786075266558.

Complementary:
- Bermejo Barrera, A.; Bermejo Barrera, Mª del Pilar; Bermejo Barrera, Adela. Química analítica general, cuantitativa e instrumental. Ed. corr. y ampl. Madrid: Paraninfo, 1991. ISBN 8428318085.
- Harvey, David. Química analítica moderna. Madrid: McGraw-Hill Interamericana, 2002. ISBN 8448136357.

RESOURCES

Other resources:
Teaching digital material (UPC Commons videos, multimedia material; Power Point presentations).
Collection of Exercises.
Virtual digital support (Athena).
The physical space (the classroom with a blackboard and audiovisual support to teach the classes. Classrooms to be able to work in groups).