Universidad Zaragoza

Academic Year/course: 2022/23

60650 - Metrology in the Chemistry Laboratory

Syllabus Information

Academic Year: 2022/23
Subject: 60650 - Metrology in the Chemistry Laboratory
Faculty / School: 100 - Facultad de Ciencias
Degree: 540 - Master's in Industrial Chemistry
ECTS: 3.0
Year: 1
Semester: Second semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

The main objective of the subject is to achieve a very practical vision about measuring in chemistry. Such vision, based on the understanding of the basic principles regulating the quality of measurements, should make it possible to:

1. Present results of measurements in a consistent way with their quality
2. Adjust the requirements of the measuring system and of each one of the steps of the measuring process to the type of the information required to solve a problem of industrial or environmental nature
3. Assess the quality parameters of the information obtained in any measuring system, particularly in those dealing with chemical systems, and diagnose any possible problem with effect on quality
4. Calibrate and assess the state of mass balances, volumetric material and other simple measuring devices
5. Design, implement and assess the calibration system best adapted to transform instrumental data into concentration
6. Design and implement the quality system required to ensure that the information obtained by the measuring system fulfils the pre-established requirements
7. Take statistically contrasted decisions with base on the data obtained and on their specific quality characteristics

Contribution to ODSs

This subject is essential for informed and statistically supported decision taking and for the acquisition of the required information about chemical systems. From this point of view, contributes to ODSs2 (food safety, nutrition, sustainable agriculture), 3 (healthy life), 8 (sustainable economical growth), 9 (innovation) and 13 (measures against climate change)

1.2. Context and importance of this course in the degree

This subject is optional within the Industrial Chemistry Master and its purpose is to provide to the student knowledge and skills related to obtaining, presenting, assessing and diagnosing data related to chemical systems, and also to the management of measuring systems. These skills are necessary in any department of chemical industries, particularly in quality control, process control and analytical laboratory.

1.3. Recommendations to take this course

None apart from those required for the Master

2. Learning goals

2.1. Competences

The students, once this subject has been approved, will become more competent for:

Identifying, analyzing and defining the quality requirements of the information of chemical nature, needed for solving problems in the industrial and environmental chemistry.

Manage, discriminate, and select the pertinent literature sources

Use effectively information and communication technologies as working tools

Use scientific English, both for getting information and for transferring it.

Design and execute the tests required to obtain reasonable estimates of the quality parameters of the information provided by any measuring system

Present results of the measurement consistently with their quality

Calibrate and diagnose balances, volumetric material and other simple measuring devices

Diagnose and eventually, correct, the problems associated to lack of quality of measurements obtained with a measuring system of chemical nature, assessing the whole measuring system, step by step.

Propose the calibration system most adequate to transform the measured signals in concentration data

Take decisions supported by statistical validated criteria from the data and their quality

2.2. Learning goals

To pass this subject, the student will have to demonstrate the following results:

Knows the nature of the basic principles determining the quality of measuring systems (traceability, accuracy and uncertainty) of chemical nature and it is able to interpret them in the context of problem solving within the industrial and environmental fields.

Knows and is able to apply the different tests required to assess the quality of the results of measuring processes.

Is able to analyze, step by step, the measuring systems in chemistry, determining the contribution to the uncertainty and accuracy (bias) of the result of each methodological step.

Is able to calibrate and diagnose mass balances, volumetric material and other simple measuring devices.

Is able to design, implement and assess the most adequate calibration system

Is able to design a system, consistent with the quality requirements of the information demanded, to validate and control the quality of the results obtained with a measuring system.

Is able to take decisions backed by inferential statistics from the data obtained and from their quality characteristics.

2.3. Importance of learning goals

The learning goals of this subject will provide the student with the necessary knowledge and tools to design, assess and optimize measuring systems of chemical nature, consistently with the basic rules governing the quality management of measuring systems and with the specific requirements of the industrial or environmental problem to be solved. Also to take decisions consistent with the levels of uncertainty and accuracy of those results. This decision-taking process is crucial in the development of competitiveness and in the quality of the products of the chemical industry.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

The score will be obtained from the assessment of the student progress by the different problems, practical cases and question tests proposed along the course.

Optionally, the student will be able to pass an exam containing theoretical and practical questions and problems in the periods corresponding to the official examination dates.

A minimum score of 5,0 will have to be obtained to pass the subjecte.

Scores above 4,0 will be kept during all the different official examination periods of the term.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. It is based on:

- M1: 12 Lectures: large group sessions (1.2 ECTS).
- M2: 12h Numerical problems and case studies sessions in small groups (1.2 ECTS).
- M3: 6 h numerical problems with spreadsheets (0.6 ECTS)
- M4: Autonomous work and study.

That favor the development/acquisition of:

- C1: Traceability evaluation of analytical methods.

- C2: Uncertainty evaluation of analytical methods.
- C3: Using the uncertainty of analytical results for problem solving in the chemical industry.

A wide range of teaching and learning tasks are implemented, such as: lectures, problem solving and case study, computer case study and workshop of cases studies.

Students are expected to participate actively in the class throughout the semester.

Classroom materials will be available via Moodle. These include a repository of the lecture notes used in class, the course syllabus, as well as other course-specific learning materials, including a discussion forum.

Further information regarding the course will be provided on the first day of class.

4.2. Learning tasks

This is a 3 ECTS course organized as follows:

- AF1 (1.2 ECTS: 12h) Lectures. Acquisition of the knowledge needed in Chemical Metrology.
- AF2 (1.2 ECTS: 12h): Problem solving and case study.
- AF3 (0.6 ECTS: 6h): Computer case study.

4.3. Syllabus

The course will address the following topics:

Lectures

Section 1. Core Concepts in Chemical Metrology: techniques, methods, measurement systems and traceability.

Section 2. Basic elements of statistical inference
Section 4. Accuracy and uncertainty in the measurement of mass.

Section 5. Accuracy and uncertainty in the measurement of volume.

Section 6. Bottom-up strategies to measure uncertainty of analytical results attending to Eurachem

Section 7. Univariate linear calibration of analytical methods

Section 8. Validation and quality control of analytical systems

4.4. Course planning and calendar

The subject will be taught in the second semester.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the "Facultad de Ciencias?website *(https://ciencias.unizar.es/calendario-y-horarios;)*

4.5. Bibliography and recommended resources

Recommended

1. Quality Assurance in Analytical Chemistry. E. Prichard, V. Barwick, Ed. Wiley-VCH .2007.

2. Garantía de calidad en los laboratorios analíticos. R. Compaño, A. Ríos, Ed. Síntesis 2010

3.- Evaluación de datos de medición Guía para la Expresión de la Incertidumbre de Medida. EDICIÓN DIGITAL 1 en español (traducción 1ª Ed. Sept. 2008) Primera edición Septiembre 2008. Centro Español de Metrología.

4.- Metrología química en el laboratorio analítico y bioanalítico. Vicente Ferreira, Universidad de Zaragoza Apuntes de la asignatura

5.- EURACHEM / CITAC Guide CG 4 Quantifying Uncertainty in Analytical Measurement. Third Edition Editors S L R Ellison (LGC, UK) A Williams (UK)

Other resources

- Excel ®
- Unscrambler 7.0 ®
- Classroom materials