Universitat de Lleida

DEGREE CURRICULUM

INSTRUMENTAL TECHNIQUES

Coordination: ERAS JOLI, JORDI

Academic year 2022-23

INSTRUMENTAL TECHNIQUES 2022-23

Subject's general information

Subject name	INSTRUMENTAL TECHNIQUES
Code	101617
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	

Degree	Course	Character	Modality
Bachelor's Degree in Biotechnology	2	COMPULSORY	Attendance-based

Course number of credits (ECTS)	6
Type of activity, credits, and groups	

Activity type	PRALAB	PRAULA		TEORIA
Number of credits	2	0.8	0.2	3
Number of groups	8	2	1	1

Coordination	ERAS JOLI, JORDI
Department	CHEMISTRY
Important information on data processing	Consult this link for more information.

INSTRUMENTAL TECHNIQUES 2022-23

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
ALVES MACEDO, JOAO CARLOS	joaocarlos.alves@udl.cat	1,2	
COMPANYS FERRAN, ENCARNACION	encarna.companys@udl.cat	1,2	
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Subject's extra information

Laboratory practices are of utmost importance in this course, so they are mandatory, i.e., to pass the course it is a requirement to have performed the practices and submit the corresponding report.

Learning objectives

The student, when passing the subject, must be able to:
• Know the procedures for acquisition, storage and preparation of the sample for each instrumental technique.
• Know the basics of current instrumental techniques, applications and limitations.
• Be able to correctly interpret the information provided by each instrumental technique.
• Learn to put into practice specific analyzes and know how to apply statistical and computer calculations to provide a reliable result.
• Know the basic processes of an instrumental analysis laboratory and the existence of computer programs and portals related to instrumental analysis.
• Acquire a criterion of choice of the most appropriate analytical technique.
• Achieve the scientific foundation sufficient to adapt to any technique or emerging method.

Competences

CG1 Be able to selectively search and use sources of information necessary to achieve the training objectives.

CG4 Know and properly use the scientific and technical vocabulary typical of the different areas of Biotechnology.

CG5 Work in the laboratory applying quality criteria and good practice.

CG7 Use the scientific method to analyze data and design experimental strategies with biotechnological applications.

CG11 Acquire criteria for choosing the most appropriate analytical techniques for each specific practical case.

CE26 Be able to use experimental techniques for analysis at the molecular, cellular and physiological level.

CE27 Know and know how to apply techniques for the analysis of molecular structures and for the detection and quantification of metabolites and macromolecules.

CE28 Know and know how to apply the techniques of omic analysis and interpretation of the results.

CE35 Know the operation and be able to work in a biotechnology laboratory.

Subject contents

UNIT 1. INTRODUCTION TO THE INSTRUMENTAL ANALYSIS. The analytical process. Analytical quality parameters. Organization of the instrumental laboratory. Registration of samples and data. Analytical materials and reagents. Mass and volume measurements. Sample preparation. Interference removal. Extractions and digestions. Analysis of majority, minority, trace and ultratrace components. Standards and Calibration Methods. Solving quantification problems by calibrating with standards

UNIT 2. SPECTROSCOPIC TECHNIQUES. Electromagnetic radiation. Ones. Absorption and emission of radiation. Spectra. Lasers. Classification of instrumental methods according to physical basis. Quantitative spectroscopy. Lambert-Beer law. Non-spectroscopic optical methods. Polarimetry and refractometry.

UNIT 3. ATOMIC SPECTROSCOPIES. Theory of atomic absorption and emission spectroscopies. Flame and plasma atomization. Applications of plasma atomic emission spectrophotometry.

UNIT 4. MOLECULAR SPECTROSCOPIES I. Theory of Molecular Spectroscopies. Molecular absorption spectroscopy. Molecular absorption in the ultraviolet-visible (UV-Vis) region. Molecular emission spectroscopy. Fluorescence. Phosphorescence.

UNIT 5. MOLECULAR SPECTROSCOPIES II. Molecular absorption in the infrared (IR) region. Medium infrared absorption, FTIR. Interpretation of medium infrared spectra (FTIR). Far infrared absorption. Near-infrared absorption, NIR spectroscopy. Raman dispersion spectrophotometry.

UNIT 6. MOLECULAR SPECTROSCOPIES III. Nuclear Magnetic Resonance (NMR) spectroscopy. Physical foundations of NMR spectroscopy. Chemical displacement. Shielding. 1 H NMR. 13 C NMR. Other cores (31P, 19F, 15N) NMR spectrum interpretation exercises.

UNIT 7. SEPARATIVE TECHNIQUES. Theory of chromatographic separations. General description. Classification of chromatographic techniques. Chromatographic parameters. Retention time. Distribution coefficient. Resolution. Qualitative analysis. Quantitative analysis. Liquid chromatography, CL. Thin layer chromatography (CCP). Rf. Column chromatography (CC). High resolution liquid chromatography, HPLC and UPLC. Gas chromatography, CG. Two-dimensional chromatography. Theory of electrophoretic separations. Gel electrophoresis. Capillary electrophoresis. Chromatography problems. Calculation of response factors.

UNIT 8. MASS SPECTROMETRY. Mass spectrometry theory. Mass spectra. Coupled systems. Interfaces, ionization techniques and analyzers. MS-MS sequential mass spectroscopy. Isotopic relationships. Too exact. Macromolecule analysis and elemental analysis by mass spectroscopy. Identification of compounds with spectroscopic techniques

Practical activities (Indicative. They can change for others, if it is considered appropriate)

PRACTICE 1. Determination of calcium in yeast by induction coupled plasma atomic emission spectroscopy (ICP-AES).

PRACTICE 2. Quantification of chlorophyll in plant tissue by UV-Vis spectroscopy.

PRACTICE 3. Quantification of the majority of cereal products by NIR. FTIR spectroscopy. Purity of commercial caffeine and methyl salicylate.

PRACTICE 4. Structural elucidation of drugs by NMR. Study of the catalytic efficiency of enzymes in fungal mycelium and commercial NMR enzymes

PRACTICE 5. Determination of the acidic profile of saponifiable lipids in a sample of bacteria and fungi by CG-FID.

PRACTICE 6. Determination of vitamins in commercial pharmaceutical preparations by HPLC with PDA and fluorescence detection

Methodology

Due to the exceptionality at the beginning of the 2020-2021 academic year, the methodology will be adapted to the guidelines set by the academic authorities. Thus, a significant part of the contact hours of the theory part can be done in non-contact mode. As for the problem and practice sessions, it is initially envisaged that they will be carried out in person. In the event that the circumstances did not make it possible, alternatives would be implemented in a non-contact mode.

Type of activity	**Description**	**Presence activity student**		**Non-contact activity student**
		Objectives	**Hours**	**Student work**
Master class	Master class (Classroom. Large group)	Explanation of the main concepts	30	Study: Knowing, understanding and synth
Seminar	Participatory class (Medium group)	Conducting discussion or application activities	10	Solving problems. Discuss
Laboratory	Practical of Laboratory (Medium group)	Execution of the practice: Understand phenomena, measure ...	20	Study and make memory
Totals			60	

Development plan

PROFESSOR DATA:

NAME: Jordi Eras Joli. DEPARTMENT: Chemistry

OFFICE: Main Ed. (A). Ground floor 0.06.4

PHONE: 973 702589 MAIL: eras@quimica.udl.cat

OFFICE HOURS: Friday from 10:30 a.m. to 12:30 p.m. Afternoons from 5pm to 6pm. Also to be agreed by e-mail. IMPORTANT: If it is through the CV always check the box:

Send as copy

Send a copy to the email address (es) of the recipients

VIRTUAL CAMPUS: Program and Bibliography. Theory. Problems. Practices. Exams Notes.

LANGUAGE: Catalan SHEET: It is not mandatory to deliver it.

MOBILE PHONE: Its use is NOT ALLOWED in class sessions. Nor leave the classroom to make use.

INSTRUMENTAL TECHNIQUES 2022-23

Academic data:

CLASSES OF THEORY AND SEMINARS

- Attendance from the first day is recommended to theory classes and seminars, since the evaluation of the theory part will be based, mainly, on the one derived from the explanations provided to class hours. The topics will be presented with PowerPoint slides and will be available in pdf format in the CV.

- The seminars classes will mainly deal with numerical exercises, spectrum resolution and case studies.

PRACTICES

- Attendance at all laboratory practices is mandatory and it is essential to present the report of all laboratory practices to pass the subject. The unjustified non-attendance means not being able to attend the exams.

Internship group changes are not allowed without the permission of the Degree Coordinator.

- It is mandatory to go to the laboratory with a long, closed and long-sleeved white coat. Footwear closed, will not be allowed to enter the laboratory with sandals. Safety glasses and gloves mandatory use. Notebook and pen to take notes.

- Two practice reports must be submitted, with deadlines for delivery
- The report can be presented together with the practice partner.

- The report must be delivered by sending it through the Virtual Campus in pdf or doc format. Each practice must be sent separately to each of the teachers who have directed the practices.

- The report should include: the objective of the practice, experimental observations, calculations, results, conclusions and answer to possible questions of the script.

DO NOT COPY THE PRACTICE SCRIPT.

It does not need to be very extensive, but it must contain the essential and done with a computer.

- The practice scripts will be posted on the virtual campus, but on the day of practice each student will also have a copy of the practice script to consult. The same copy should serve all three groups, therefore, it cannot be scratched or worn.

EVALUATION

- In the evaluation of the subject, the whole set of teaching will be taken into account. The theory and seminars part will evaluate, mainly, with the exams. These will consist of questions corresponding to the theoretical explanations in theory classes and seminars, questions about the scientific articles that will be proposed and questions about the practice sessions in relation to the foundation, experimental development, the results and the final conclusions of the practice. The exercises proposed in the theory classes and seminars will also be evaluated.

The active attitude in the set of activities of the subject (appropriate questions, comments, general interest) will be taken into account.

The evaluation of the practice sessions will be carried out assessing the corresponding report and the attitude when carrying out the practice.

- A partial exam will be done in the month of March or April. Aprova'l means having provisionally approved that part of the subject and the June exam would only go with the second part. In case of suspending the first part, in June there will be an exam that includes the first and second part. In the recovery exam he only goes with the whole subject.

I**MPORTANT:**

To have passed the subject is a necessary condition, but not unique, having passed or both partial exams or the entire exam.

In relation to the final grade of a call, the marks corresponding to the evaluations of the activities in the seminars and laboratory will only be taken into account if the theory note is exceeded by a minimum of 5.

Evaluation

The evaluation tests can be face-to-face, semi-face-to-face or mixed. The modalities in case of non-face-to-face tests will be the appropriate ones among those that are included in the section of Test and questionnaires of the Virtual Campus.

Laboratory practices are of utmost importance in this course, so they are mandatory, i.e., to pass the course it is a requirement to have performed the practices and submit the corresponding report.

Theory	Seminar	Laboratory
50 %	30 %	20 %

Bibliography

Basic

- **Randazzo A. (2018). Guia Práctica para la Interpretación de Espectros de RMN (1ª Ed.), Loghia Publishing. Nápoles.**
- **Harris D.C. (2006), Anàlisi Química Quantitativa (6ª Ed), Reverté, Barcelona.**
- **Skoog D.A., Holler, F.J., Nieman T.A. (2001), Principios de Anàlisis Instrumental, (5ª Ed) McGraw-Hill / Interamericana, Madrid.**
- **Skoog D.A., West D.M., Holler F.J., Crouch S.R. (2005), Fundamentos de Química Analítica, (8ª Ed) Thomson, Madrid.**
- **Rubinson J.F., Rubinson K.A. (2001), Análisis instrumental, Prentice Hall, Madrid.**
- **Harvey D. (2002), Química analítica moderna, McGraw-Hill / Interamericana, Madrid.**

Complementary

- **A.O.A.C. (2006), Official Methods of Analysis, Association of Official Analytical Chemists International (18th Ed). Williams Horwitz (Ed).**
- **Stoeptler M. (Ed) (1997), Sampling and Sample Preparation, Springer-Verlag, Berlin, Heidelberg.**
- **Miller J.C., Miller J.N. (2002), Estadística y Quimiometria para Química Analítica, (4a Ed), Ed Prentice Hall, Madrid.**
- **Ebdon L, Evans E.H., Fisher A., Hill S.J. (1998), An Introduction to Analytical Atomic Spectrometry, Wiley.**
- **Cullen M. (Ed) (2004), Atomic Spectroscopy in Elemental Analysis, CRC Press.**
- **Freeman R. (2003), Magnetic Resonance in chemistry and medicine, Oxford University Press, Oxford.**
- **Hobokenn J. (2006), Principles of Mass Spectrometry applied to biomolecules. Wiley-Interscience.**