COURSE DATA

DATA SUBJECT

Code: 47141
Name: Técnicas de caracterización de compuestos inorgánicos y sus interacciones
Cycle: Master's Degree
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
2288 - M.U. en Técnicas Experimentales en Química	Facultat de Química	1	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2288 - M.U. en Técnicas Experimentales en Química	Técnicas de caracterización de compuestos inorgánicos y sus interacciones	COMPULSORY

COORDINATION

GONZALEZ GARCIA JORGE

SUMMARY

Laboratory-based course focused on learning advanced methodologies used in:

- the study of interactions between transition-metal complexes and nucleic acids
- the structural determination based on the use of nuclear magnetic resonance spectroscopy and spectral interpretation and,
- techniques used in the study of crystalline solids, such as electron microscopy and powder X-ray diffraction.

In relation to the Sustainable Development Goals (SDGs), this course is expected to enable students to apply the knowledge acquired in order to contribute to ensuring inclusive, equitable and quality education and to promote lifelong learning opportunities for all (SDG 4); to develop a particular awareness of the sustainable management of water (SDG 6), raw materials and energy sources (SDG 7); and to foster sustainable development compatible with environmental protection (SDGs 11, 12, 13, 14 and 15).
In addition, students are expected to be able to design, select and/or develop efficient chemical products and processes, as well as analytical methodologies (SDG 7), that minimize their environmental impact (SDGs 14 and 15), make use of alternative raw materials and generate a lower amount of waste (SDG 11).

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

COMPETENCES / LEARNING OUTCOMES

DESCRIPTION OF CONTENTS

1. Procedures for the study of bioinorganic interactions using advanced techniques

- Study of the interaction between transition metal complexes and DNA by means of thermal denaturation and fluorescence spectroscopy.
- Study of the mobility of DNA–complex systems by polyacrylamide gel electrophoresis in order to determine the type of interaction between the compounds and DNA.

2. Interpretation of results

- Presentation and representation of the data obtained.
- Calculation of the affinity constant of the complex with DNA.

3. Experimental aspects of NMR

- Selection of solvent(s) and working conditions.

4. Acquisition and interpretation of spectra

- Acquisition of one-dimensional spectra of samples, covering different nuclei of interest (^{1}H, ^{13}C, ^{19}F, ^{31}P).
- Acquisition of two-dimensional homonuclear spectra (COSY).
- Acquisition of two-dimensional heteronuclear spectra (HSQC, HMBC).
- Acquisition of spectra at different temperatures.
- Acquisition of spectra of solid samples (nuclei such as ^{11}B, ^{27}Al and ^{29}Si).
- Interpretation of the spectra obtained.

5. Electron microscopy

- Preparation of samples from powdered materials (inorganic compounds, minerals and ceramic materials) for scanning electron microscopy (SEM).
- Observation and microstructural characterization of the samples by SEM. Determination of morphology and particle size.
- Determination of material composition and homogeneity by Energy-Dispersive X-ray Spectroscopy (EDX).

6. X-ray powder diffraction (XRD)

- Preparation of samples from powdered materials (inorganic compounds, minerals and ceramic materials) for XRD analysis.
- Establishment of optimal working parameters for obtaining diffraction patterns of crystalline samples.
- Acquisition of diffraction patterns of the prepared samples.
- Identification of crystalline phases in single-phase samples.
- Identification of crystalline phases in multiphase samples.
- Quantitative determination of crystalline phases in a material.
- Analysis of the composition of materials using X-ray fluorescence.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Seminar	12,00
Laboratory	48,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	12,00
Independent study and work	42,00
Preparation of lessons	12,00
Preparation for assessment activities	12,00
Resolution of case studies	12,00
Total hours	**90,00**

TEACHING METHODOLOGY

Presencial activities

Laboratory classes will begin with seminars in which the instructors will provide a brief introduction to the objective, fundamentals, and experimental methodology of the practical exercises. The instructors will provide the necessary explanations in the laboratory regarding the operation of the instruments to be used in each exercise before students use them and will supervise their use during the exercises to reinforce their understanding of the techniques employed. Students will carry out the practical exercises, following the provided lab manuals, which may be more or less flexible depending on each exercise and the specific learning objectives of the course.

The in-person activities carried out in the laboratory and in the seminars will form part of the student's continuous assessment (SE-1). Written exams will be administered on the dates scheduled in the assessment program (SE-3).

Non-presencial activities

Students will complete and submit the non-presencial activities requested by the instructors (questionnaires, reports, lab reports, etc.) within the specified deadline. These activities will form part of their assessment (SE-2).

EVALUATION

FIRST EXAMINATION PERIOD

Student learning assessment will take into account all aspects outlined in the methodology section of this course guide. The assessment will consist of three parts:

SE1 - Continuous assessment of students in laboratory classes and seminars: participatory attendance, handling of materials and equipment, work organization, understanding and use of the lab manual, calculations, teamwork, etc. Preparation for the lab session before the start of the session. During seminar and laboratory sessions, which focus on solving practical cases, student attendance and active participation will be assessed individually (either by answering questions posed by the instructors orally or in writing, or by asking questions whose answers are relevant to the rest of the group). These questions will cover theoretical and practical knowledge, the design of work protocols, variable selection, and data processing tools, among other topics. Practical sessions will be conducted in working groups. Activities that are part of the continuous assessment cannot be retaken in the second examination period.

WEIGHTING 20%

SE2 - Assessment of non-presencial activities related to laboratory classes: reports and/or summaries of the practical sessions submitted. The reports submitted by students will include the main conclusions derived from the laboratory work (work protocols, variable selection, and data processing) and will be carried out in pairs to promote teamwork. These activities can be retaken in the second examination period.

WEIGHTING 40%

SE3 - Written exam: based on the learning outcomes and the specific objectives of each subject. The exam will consist of solving questions or practical cases related to the techniques studied and laboratory practices carried out. The exam can be retaken in the second examination period.

WEIGHTING 40%

The minimum grade obtained in each of the assessed sections must be equal to or higher than 4.5 in order to have them averaged. The minimum overall grade to pass the course is 5.0.

Attendance at all seminars and all laboratory sessions is mandatory and cannot be retaken. In case of a justified absence, one, two, or three sessions, at most, may be made up by attending another practical group, if the laboratory's teaching schedule allows it. The grade for any missed session will be zero. Missing or not making up more than three sessions will result in a failing grade for the course.

Clear copying or plagiarism of any assignment that forms part of the assessment will result in failing the course and will be subject to the appropriate disciplinary procedures. It should be noted that, according to Article 13 d) of the University Student Statute (Royal Decree 1791/2010, of December 30), "it is the duty of a student to refrain from using or cooperating in fraudulent procedures in assessment tests, in assignments, or in official University documents."

SECOND EXAMINATION PERIOD

In the second exam session, the grade will be obtained applying the same criteria as in the first session.

REFERENCES

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