



Teaching Guide

| Teaching Guide | | | | |
|--------------------------|---|--------|-------------------------------|---------|
| Identifying Data | | | | 2022/23 |
| Subject (*) | Fluorescence Spectroscopy and Photochemistry | Code | 610509108 | |
| Study programme | Mestrado Universitario en Investigación Química e Química Industrial (Plan 2020) | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Official Master's Degree | 1st four-month period | First | Optional | 3 |
| Language | Spanish | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Departamento profesorado másterQuímica | | | |
| Coordinador | Fernandez Perez, Maria Isabel | E-mail | isabel.fernandez.perez@udc.es | |
| Lecturers | Fernandez Perez, Maria Isabel Novo , Mercedes Wajih , Al-Soufi | E-mail | isabel.fernandez.perez@udc.es | |
| Web | https://www.usc.gal/gl/estudos/masteres/ciencias/master-universitario-investigacion-quimica-quimica-industrial/20212022/e-spectro | | | |
| General description | <p>Subject objectives</p> <p>The general aim of this course is that the students learn the fundamental aspects of electronic spectroscopy, in particular of fluorescence, and photochemistry. Special attention will be paid to the utility of fluorescence to know the molecular behavior in excited electronic states and in the applications of fluorescence in Chemistry, Biology and Medicine. At the end of the course the student should be able:</p> <p>? To understand the fundamentals of electronic spectroscopy and fluorescence and the molecular features in excited electronic states.</p> <p>? To know the fluorescence techniques to measure fluorescence.</p> <p>? To describe the fluorescence quenching mechanisms and their utility.</p> <p>? To understand the mechanisms of electronic energy transfer and their use in structural studies.</p> <p>? To know how to use different fluorescence methods to obtain structural and dynamic information about the molecular and supramolecular environment.</p> <p>? To know the most important types of fluorescence probes and their applications.</p> <p>? To do fluorescence measurements confidently and correctly.</p> | | | |

Study programme competences / results

| Code | Study programme competences / results |
|------|--|
| A1 | Define concepts, principles, theories and specialized facts of different areas of chemistry. |
| A3 | Innovate in the methods of synthesis and chemical analysis related to the different areas of chemistry |
| A7 | Operate with advanced instrumentation for chemical analysis and structural determination. |
| B2 | Students should apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study. |
| B3 | Students should be able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments. |
| B7 | Identify information from scientific literature by using appropriate channels and integrate such information to raise and contextualize a research topic |
| B10 | Use of scientific terminology in English to explain the experimental results in the context of the chemical profession |
| B11 | Apply correctly the new technologies to gather and organize the information to solve problems in the professional activity. |
| C1 | CT1 - Elaborar, escribir e defender publicamente informes de carácter científico e técnico |
| C3 | CT3 - Traballar con autonomía e eficiencia na práctica diaria da investigación ou da actividade profesional. |
| C4 | CT4 - Apreciar o valor da calidade e mellora continua, actuando con rigor, responsabilidade e ética profesional. |

Learning outcomes



| Learning outcomes | Study programme competences / results | | |
|-------------------|---------------------------------------|-----------------------------------|-------------------|
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |
| | AC1 AC3 AC7 | BC2 BC3 BC7 BC10 BC11 | CC1 CC3 CC4 |

| Contents | |
|--|---|
| Topic | Sub-topic |
| 1. Fundamentals of electronic spectroscopy and fluorescence spectroscopy | Luminiscent phenomena. Radiative and nonradiative processes. Fluorescence excitation and emission spectra. Fluorescence quantum yield. Fluorescence lifetime. Effect of environment on fluorescence. |
| 2. Experimental techniques | Measurement of fluorescence spectra: the spectrofluorometer. Correction of excitation and emission spectra. Measurement of fluorescence lifetimes. Measurement of fluorescence polarization. Ultrafast techniques. Single-molecule fluorescence. Fluorescence Microscopy. |



| | |
|---|--|
| 3. Fluorescence quenching | Collisional or dynamic quenching. Stern-Volmer equation. Static quenching. Static and dynamic quenching. Applications to study complex formation and microheterogeneous systems. |
| 4. Excited electronic states and photochemistry | Excited-state complex formation: excimers and exciplexes. Photoinduced electron transfer. Photoinduced proton transfer. Other photochemical reactions. |
| 5. Electronic energy transfer | Electronic energy-transfer mechanisms. Förster Resonance Energy Transfer (FRET). Applications for the measurement of molecular distances and the study of supramolecular associations. Dexter mechanism of energy transfer: photosensitization and photodynamic therapy. |
| 6. Fluorescence probes | Classes of fluorescence probes: intrinsic and extrinsic. Green Fluorescence Protein. Quantum dots. Applications in biomedicine, analyses, environment, and materials studies. |

| Planning | | | | |
|---|---------------------------------|--------------------------------------|-------------------------------|-------------|
| Methodologies / tests | Competencies / Results | Teaching hours (in-person & virtual) | Student's personal work hours | Total hours |
| Guest lecture / keynote speech | A1 B2 B3 B10 | 12 | 6 | 18 |
| Seminar | A7 B2 B3 B7 B10 | 7 | 13 | 20 |
| Supervised projects | A3 B2 B3 B7 B10 B11 C1 C3 C4 | 20 | 13 | 33 |
| Speaking test | C1 C3 | 0 | 0 | 0 |
| Objective test | A1 A3 A7 B2 B10 C4 | 2 | 0 | 2 |
| Personalized attention | | 2 | 0 | 2 |
| (*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students. | | | | |

| Methodologies | |
|--------------------------------|-------------|
| Methodologies | Description |
| Guest lecture / keynote speech | |
| Seminar | |
| Supervised projects | |
| Speaking test | |
| Objective test | |

| Personalized attention | |
|------------------------|--|
| Methodologies | Description |
| Supervised projects | Tutorías programadas por el profesor y coordinadas por la Comisión Académica del Máster. Supondrán para cada alumno 2 horas. |

| Assessment | | | |
|---------------------|---------------------------------|---|---------------|
| Methodologies | Competencies / Results | Description | Qualification |
| Seminar | A7 B2 B3 B7 B10 | Evaluation of problems submitted for each topic: 10%. Evaluation of practical cases: 20% | 30 |
| Supervised projects | A3 B2 B3 B7 B10 B11 C1 C3 C4 | Oral presentation of a research article: 10%. | 10 |
| Objective test | A1 A3 A7 B2 B10 C4 | 60% of the final mark: evaluation of the final exam of the subject with conceptual questions and problems | 60 |



Assessment comments

The passing grade will be obtained for a final grade of 5 out of 10. The final grade, both of first and second opportunity, will be based on the evaluation of the following aspects:

? 40% of the final mark: continuous evaluation based on the following contributions:

Evaluation of problems submitted for each topic: 10%.

Evaluation of practical cases: 20%

Oral presentation of a research article: 10%.

? 60% of the final mark: evaluation of the final exam of the subject with conceptual questions and problems, complementary to the continuous evaluation both in the first and second opportunity and in any of the scenarios. It will be necessary to obtain a minimum mark of 4 out of 10 in the exam to pass the course.

The assessment of students who repeat the subject will be governed by the same assessment standards as that of students taking the subject for the first time.

PLAGIARISM AND MISUSE OF TECHNOLOGIES IN THE CONDUCT OF TASKS OR TESTS: "For cases of fraudulent execution of exercises or tests, the provisions of the Regulations for the evaluation of student academic performance and revision of qualifications will apply."

CONTINGENCY PLAN FOR REMOTE TEACHING ACTIVITIES: The evaluation system will be the same regardless of the type of teaching used (face-to-face or virtual), with the only difference that the evaluation activities will be carried out, according to what the competent authorities establish, either in person in the classroom or remotely through the telematic means available at the USC.

Sources of information

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|----------------------|---|
| Basic | <ul style="list-style-type: none">- Joseph R. Lakowicz (2006). Principles of Fluorescence Spectroscopy, 3rd Ed. Springer, New York- Bernard Valeur (2012). Molecular Fluorescence. Principles and Applications, 2nd Ed. Wiley-VCH, Weinheim- Petr Klán y Jacob Wirz (2009). Photochemistry of Organic Compounds: From Concepts to Practice,. Wiley, Chichester- Paul R. Selvin y Taekjip Ha (2008). Single-Molecule Techniques. A laboratory manual. Cold Spring Harbor Laboratory Press, New York <p>Review and research articles related to the subject.</p> |
| Complementary | |

Recommendations

Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.