Teaching Guide				
Identifying Data				2021/22
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	E-mail	isabel.fernandez.perez@udc.es	
Web	https://www.usc.gal/gl/estudos/masteres/ciencias/master-universitario-investigacion-quimica-quimica-industrial/20212022/espectro			
General description	Subject objectives 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: ? To understand the fundamentals of electronic spectroscopy and fluorescence and the molecular features in excited electronic states. ? To know the fluorescence techniques to measure fluorescence. ? To describe the fluorescence quenching mechanisms and their utility. ? To understand the mechanisms of electronic energy transfer and their use in structural studies. ? To know how to use different fluorescence methods to obtain structural and dynamic information about the molecular and supramolecular environment. ? To know the most important types of fluorescence probes and their applications. ? To do fluorescence measurements confidently and correctly.			
Contingency plan	CONTINGENCY PLAN FOR REMOTE TEACHING ACTIVITIES: The remote teaching activities would be carried out synchronously/asynchronously and always according to the schedule established by the center, through the different telematic means available at the USC, preferably the Virtual Campus and MS Teams. Seminars and tutorials, as well as the direct communication both between the students themselves and between them and the teacher, can be done through discussion forums in the Virtual Campus, through MS Teams or, in exceptional cases, by email. In scenario 2, two modalities are contemplated, 100% physical presence, in the case of small groups, and / or the teaching organization allows it; and a combination of 50% physical presence and 50% telematics. In the combined mode, the groups of lectures will be subdivided, which will have alternate face-to-face teaching, that is, half of the students will be in the classroom and the other half will follow the class via MS Teams. The implementation of the combined modality will be conditional on the availability of sufficient teaching spaces.			

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
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	
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	
Basic	- 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
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.