Teaching Guide				
Identifying Data				2023/24
Subject (*)	Molecular Machines		Code	610G04036
Study programme	Grao en Nanociencia e Nanotecnoloxía			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Optional	4.5
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	BioloxíaQuímica			
Coordinador	Brea Fernández, Roberto Javier		E-mail	roberto.brea@udc.es
Lecturers	Brea Fernández, Roberto Javier Criado Fernández, Alejandro Freire Picos, María Ángeles Rodriguez Belmonte, Esther		E-mail	roberto.brea@udc.es a.criado@udc.es maria.freirep@udc.es esther.belmonte@udc.es
Web				
General description	This subject focuses on the study of the biochemical and chemical principles that constitute molecular machines (natural and/or synthetic), with special emphasis on the potential applications that they present in multiple fields.			

Study programme competences / results	
Code	Study programme competences / results
A4	CE4 - Desarrollar trabajos de síntesis y preparación, caracterización y estudio de las propiedades de materiales en la nanoescala.
A5	CE5 - Conocer los rasgos estructurales de los nanomateriales, incluyendo las principales técnicas para su identificación y caracterización
A7	CE7 - Interpretar los datos obtenidos mediante medidas experimentales y simulaciones, incluyendo el uso de herramientas informáticas, identificar su significado y relacionarlos con las teorías químicas, físicas o biológicas apropiadas.
B1	CB1 - Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
B4	CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado
B5	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
B7	CG2 - Resolver problemas de forma efectiva.
B8	CG3 - Aplicar un pensamiento crítico, lógico y creativo.
B10	CG5 - Trabajar de forma colaborativa.
C2	CT2 - Dominar la expresión y la comprensión de forma oral y escrita de un idioma extranjero
C3	CT3 - Utilizar las herramientas básicas de las tecnologías de la información y las comunicaciones (TIC) necesarias para el ejercicio de su profesión y para el aprendizaje a lo largo de su vida
C7	CT7 - Desarrollar la capacidad de trabajar en equipos interdisciplinares o transdisciplinares, para ofrecer propuestas que contribuyan a un desarrollo sostenible ambiental, económico, político y social.
C8	CT8 - Valorar la importancia que tiene la investigación, la innovación y el desarrollo tecnológico en el avance socioeconómico y cultural de la sociedad
C9	CT9 - Tener la capacidad de gestionar tiempos y recursos: desarrollar planes, priorizar actividades, identificar las críticas, establecer plazos y cumplirlos

Learning outcomes

Learning outcomes	Study programme competences / results		
Acquire basic knowledge related to molecular machines	A5	B1 B8	C8
Manage the main bibliographic sources in the field of molecular machines		B4 B8	C2 C3 C9
Develop the ability to expose and solve basic problems related to molecular machines and their applications	A4 A5 A7	B4 B5 B7 B10	C2 C3 C7 C9
Know various techniques for the synthesis, characterization and application of molecular machines	A4 A5 A7	B7 B8	C2
Interpret data from experimental observations	A7	B1 B4 B7 B8	

Contents	
Topic	Sub-topic
Topic 1. Biomolecular machines for the handling of information. polymerases and ribosomes	DNA and RNA polymerases and factors necessary for the correct synthesis. Messenger replacement. Riboswitches and LncRNAs, use of molecular tweezers in transcription studies. Protein synthesis. The canonical and non-canonical translation and translation modulation.
Topic 2. Biomolecular machines for transport, movement, transduction of signals and energy optimization	Transport and movement: transport proteins through microtubules and microfilaments. Obtaining energy: ATPases. Adjustment of electron transport chains to ATP synthesis. Signal transduction and molecular sensors.
Topic 3. Artificial biomolecular machines	Hybrid biomolecular systems. Membrane-bound hybrid molecular machines. DNA-based synthetic molecular machines.
Topic 4. Synthetic molecular machines for movement control	Catenanes. Rotaxanes. Molecular switches. Molecular pumps. Artificial muscles. Nanovalves. Nanomotors. Self-propelled devices.
Topic 5. Synthetic molecular machines with catalytic activity	Switchable catalysts. Artificial enzymes. Artificial ribosomes.
Topic 6. Synthetic molecular machines for the conversion, transport and storage of energy	Artificial photosynthetic devices. Energy nanocarriers. Energy nanoaccumulators.

Planning

Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A5 B1	16	0	16
Events academic / information	A5 B1	3	0	3
Seminar	A5 A7 B1 B4 B5 B7 B8 B10 C2 C3 C7 C8 C9	4	20	24
Laboratory practice	A4 A5 A7 B1 B4 B5 B7 B8 B10 C2 C3 C7 C8 C9	10	10	20
Mixed objective/subjective test	B1 B4 B7 B8 C2	2	44	46
Personalized attention		3.5	0	3.5
(*)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	Theoretical classes. Expository classes (use of blackboard, computer, cannon) complemented with the tools of virtual teaching
Events academic / information	Attendance at scientific and/or informative conferences
Seminar	Interactive sessions related to the subject, in which debates and exchange of opinions are established with the students
Laboratory practice	Carrying out experiments in the laboratory and elaboration of a practice report in which the results are described and the data obtained are analyzed
Mixed objective/subjective test	Completion of the different tests to verify the acquisition of knowledge (both theoretical and practical) and the acquisition of skills and attitudes

Personalized attention	
Methodologies	Description
Seminar Laboratory practice Mixed objective/subjective test	The proposed teaching methodology is based on the work of the student, who becomes the main person in charge of their educational process. In order to get the best performance from its effort, and to guide the student in this process and determine to what extent the student is reaching the objectives proposed in each thematic unit, problem-solving sessions and practical cases will be held. These will allow students to be guided and ensure that they reach the competencies associated with the subject. Likewise, this orientation will be reinforced through individual interviews that will be held during the teacher's tutoring hours and/or at the most convenient times for the students. Obviously, and apart from these tutorials proposed by the teacher, students may attend tutorials at their own request as many times as they wish and at the times that are most convenient for them. It should be noted that during the master sessions participation in debate rounds related to the content covered in each unit will be encouraged. The hours of personalized attention will serve to clarify the fundamental concepts of the subject, as well as to resolve individual issues presented in seminars, lectures, and practices. Those students who take advantage of the regime of "recognition of part-time dedication and academic exemption from attendance" according to the regulations of the UDC, will have specific attention that will be specified in the following aspects: - These students will have, at their own request and at a time to be agreed, tutorial help for the preparation of the contents that will be worked on in the practical laboratory classes, as well as in the seminars. - Similarly, and when requested, these students will receive additional tutorial help for guidance and resolution of doubts.

Assessment			
Methodologies	Competencies / Results	Description	Qualification
Seminar	A5 A7 B1 B4 B5 B7 B8 B10 C2 C3 C7 C8 C9	Training activity of an eminently practical nature designed with the aim of influencing those aspects of the subject that are more difficult to understand. This activity will be evaluated through the active participation of the students.	30
Laboratory practice	A4 A5 A7 B1 B4 B5 B7 B8 B10 C2 C3 C7 C8 C9	During the laboratory practices, a continuous evaluation of the student's work will be carried out, the degree of understanding of the practices, the attitude and the rationalization of the experiments. Likewise, both the content and the format of the Laboratory Notebook will be evaluated.	40
Mixed objective/subjective test	B1 B4 B7 B8 C2	The mixed test will be carried out in the calendar agreed by the Faculty Board of each center. Its objective is to obtain an evaluation of the level of knowledge and competence reached by the student, as well as to evaluate the ability of the latter to relate them and to obtain an overview of the subject.	30

Assessment comments

- To pass the subject it will be necessary to achieve, added the qualifications of all the continuous evaluation activities (Seminars and Laboratory Practices), a minimum of 5 points (out of 10) and obtain a minimum of 5 points (out of 10) in the qualification of the mixed test. In the event that the students do not achieve the minimum score in any of them, if the sum of the set of all evaluable activities is greater than or equal to 5 points, the subject will appear as failed (4.5 out of 10 points).- In the case of not passing the subject at the first opportunity:1) The qualification of the Seminars and Laboratory Practices will be kept in the second opportunity in July, if it achieves a minimum of 5 points (out of 10).2) The qualification of the Mixed Test of the second opportunity of July will replace the one obtained in the Mixed Test of the first opportunity, being again necessary to reach a minimum of 5 points (out of 10) in the score of the Mixed Test to be able to pass the matter.- To obtain the qualification of not presented, the students may not have participated in more than 25% of the Laboratory Practices and Seminars, nor take the Mixed Test.
- In accordance with the academic regulations, the students who are evaluated in the "second opportunity", will only be able to opt for honorary enrollment if the maximum number of these for the course were not fully covered in the "first opportunity".
- For those students who take advantage of the
"recognition of part-time dedication or academic dispensation of exemption from attendance", we will try to adapt the schedules to their availability as far as possible. The final qualification for these students, both for the first and for the second opportunity, will follow the evaluation scheme described above.
- In the case of very exceptional, objectifiable and adequately justified circumstances, the Responsible Teacher could totally or partially exempt any member of the student body from attending the continuous assessment process. The students who had found themselves in this circumstance must pass a specific exam that leaves no doubt about the achievement of the competences of the subject.
Implications of plagiarism in the qualification:The fraudulent completion of any exercise or test of the student for the
evaluation of the subject will be subject to disciplinary
responsibilities, as stated in the Regulations for Evaluation, Review
and Claim of University Degree and Master's Degree Qualifications
(Article 11) and in the Statute of the UDC Student Body (Article 35,
point 3): "Failed grade in the call in which the offense is committed:
the student will be graded with "Fail" (numerical grade 0) in the
corresponding call of the academic year, both the fault occurs both on
the first opportunity and on the second. For this, their qualification
will be modified in the first opportunity record if necessary".
Early call for December:The weighting in the evaluation of the different teaching activities of the students who participate in the December call will be adapted to the new evaluation percentages included in this guide, in the event that these differ from each other in both the two academic years.

Sources of information

Basic	- Lodish, Harvey; Berk, Arnold; Kaiser, Chris A.; Krieger, Monty; Bretscher, Anthony (2021). Molecular Cell Biology. W H Freeman & Co - Steven, Alasdair; Baumeister, Wolfgang; Johnson, Louise N.; Perham, Richard N. (2016). Molecular Biology of Assemblies and Machines. Garland Science - Credi, Alberto; Balzani, Vincenzo (2020). Molecular Machines. 1088press - Erbas-Cakmak, Sundus; Leigh, David A.; McTernan, Charlie T.; Nussbaumer, Alina L. (2015). Artificial Molecular Machines. American Chemical Society - Balzani, Vincenzo; Credi, Alberto; Venturi, Marguerita (2008). Molecular Devices and Machines: Concepts and Perspectives for the Nanoworld. Wiley-VCH Selected scientific articles related to the subject's agenda.Selected scientific articles related to the subject's agenda.
Complementary	- Credi, Alberto; Silvi, Serena; Venturi, Margherita (2014). Molecular Machines and Motors - Recent Advances and Perspectives. Springer - Zocchi, Giovanni (2018). Molecular Machines: A Materials Science Approach. Princeton University Press Selected scientific articles related to the subject's agenda.Selected scientific articles related to the subject's agenda.

Recommendations
Subjects that it is recommended to have taken before
Supramolecular Chemistry/610G04027 Structural Biochemistry/610G04019 Molecular and Metabolic Biochemistry/610G04023
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

Gender perspective:-
According to the different applicable regulations for university
teaching, the gender perspective must be incorporated in this matter
(non-sexist language will be used, a bibliography of authors of both
sexes will be used, intervention in class of male and female
students...).- Work will be done to identify and modify prejudices
and sexist attitudes and the environment will be influenced to modify
them and promote values of respect and equality.- Situations of discrimination based on gender must be detected and actions and measures to correct them will be proposed. Green Campus Faculty of Sciences
Program

To achieve an immediate sustainable environment and comply with point 6
of the "Environmental Declaration of the Faculty of Sciences (2020)",
the documentary works carried out in this subject:

a.- They will
be requested mainly in virtual format and computer support.

b.- If done
on paper:

- Plastics
will not be used.

-
Double-sided prints will be made.

- Recycled
paper will be used.

- The realization of drafts will be avoided.

(*)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.