

## From Small Molecules to Nanomaterials 2016/2017

Code: 42423  
ECTS Credits: 6

Degree	Type	Year	Semester
4313385 Industrial Chemistry and Introduction to Chemical Research	OT	0	1

### Contact

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### Teachers

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Félix Busqué Sánchez  
Rosa María Sebastián Pérez

### Use of languages

Principal working language: english (eng)

### Prerequisites

There are no special prerequisites to attend the Module 6 but the same as to access the Master. It is required to be in possession of an official Spanish University Degree or another Degree issued by a Higher Education Institution, belonging to another member state of the European Higher Education, or from third countries empowered to access a master's degree.

On the other hand, it is desirable to have advanced knowledge of English, level B1 of the Common Reference European Framework for Languages of the European Council.

### Objectives and Contextualisation

The aim of the module is to learn and deepen the study of the properties and applications of specific relevant materials in research by focusing on supramolecular materials, nanomaterials and biomaterials. In this sense, the preparation, properties and applications of molecules based on their molecular weight and increasing structural complexity down to nanostructured materials will be studied. In this regard the following two sub blocks are splitted:

- Small molecules and dendrimers: synthesis, properties and utility. Chirality: molecular recognition and biological activity.
- Soft materials and metallic nanoparticles: synthesis, functionalization and applications

On the other hand, lecturing in English as well as evaluating the contents in English will allow the students to be familiar with the chemistry terminology as well as to consolidate an essential language for their future careers both as in companies as in a university department or a research center.

## Skills

- Apply materials and biomolecules to innovative fields of chemical industry and research.
- Correctly apply new information capture and organisation technologies to solve problems in professional activity.
- Define specialised concepts, principles, theories and facts in the different areas of Chemistry.
- Identify information in the scientific literature using the appropriate channels and integrating said information to approach and contextualise a research issue.
- Innovate in chemical synthesis and analysis methods related with different areas of Chemistry.
- Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
- Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
- Students should know how to apply the knowledge acquired and the capacity to solve problems in new or little-known areas within broader (or multidisciplinary) contexts related to their area of study
- Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
- Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

## Learning outcomes

1. Apply the synthesis of small molecules in molecular biology and medicine
2. Assess the importance of chirality in molecular recognition and biological activity
3. Correctly apply new information capture and organisation technologies to solve problems in professional activity.
4. Describe the design and synthesis of drug transporters agents
5. Identify information in the scientific literature using the appropriate channels and integrating said information to approach and contextualise a research issue.
6. Possess and understand knowledge that provides a basis or opportunity for originality in the development and/or application of ideas, often in a research context
7. Prepare and functionalise metallic nanoparticles for their application to analysis and catalysis.
8. Prepare and use dendrimers in catalysis, biology, medicine and materials.
9. Student should possess an ability to learn that enables them to continue studying in a manner which is largely self-supervised or independent
10. Students should know how to apply the knowledge acquired and the capacity to solve problems in new or little-known areas within broader (or multidisciplinary) contexts related to their area of study
11. Students should know how to communicate their conclusions, knowledge and final reasoning that they hold in front of specialist and non-specialist audiences clearly and unambiguously
12. Use scientific terminology in the English language to defend experimental results in the context of the chemistry profession.

## Content

- **Chirality: general concepts, molecular and supramolecular structures.** 2h. Pau Bayón
- **Small molecules: synthesis and applications in molecular biology and medicine.** 12 h. Ramon Alibés (6 h), Félix Busqué (6 h).
- **Dendrimers and hyperbranched molecules: preparation and applications.** 6 h. Rosi Sebastián.
- **Soft materials: polymeric coatings and gelators, Supramolecular structures.** 6 h. Carlos Jaime
- **The role of fluorine in pharmaceutical products.** 3h Adelina Vallribera
- **Nanoparticle synthesis and applications in catalysis and sensing.** 11 h. Roser Pleixats (7 h), Mar Puyol

(4 h)

- **Applications of small molecules, soft materials and nanoparticles in drug and biomolecule delivery.** 6 h. Rosa Ortuño.

## Methodology

In general the following Teaching Methodologies will be followed in all the different subjects :

- Lectures
- Problem-solving classes
- Cooperative activities
- Seminars
- Oral presentations
- Tutoring

## Activities

Title	Hours	ECTS	Learning outcomes
<b>Type: Directed</b>			
Lectures	42	1.68	2, 4, 6, 7, 8
<b>Type: Supervised</b>			
Problems solving and Seminars	5	0.2	1, 3, 9, 10
<b>Type: Autonomous</b>			
Seminars and Bibliography	103	4.12	3, 5, 9, 11, 12

## Evaluation

All subjects are compulsory attendance, and are evaluated separately by different evaluating procedures including writing exams, theoretical and practical tests, oral presentations, research papers understanding, in-class brief questions, written works, etc.

- The overall mark will be the weighted average of the grades obtained for each subject.
- To pass the module, you must obtain a minimum of 4 points (10) in all subjects.
- The subjects rated less than 4 points cannot be considered in the average.
- There will be a reevaluation for those subjects with less than 4 points.

Some previewed evaluation methods are detailed next although it may vary between different years:

- **Dendrimers and hyperbranched molecules: preparation and applications.** A written examination covering the general concepts seen during course.
- **Soft materials: polymeric coatings and gelators, Supramolecular structures.** Short exam (approx. 1h) + Presentation in pairs (10 min) based on previous work.

**- Nanoparticle synthesis and applications in catalysis and chemical analysis.**

**Catalysis:** written work (probably in the form of PowerPoint)

**Chemical analysis:** question about a research paper on the field (approx. 1h)

**- Applications of small molecules, soft materials and nanoparticles in drug and biomolecule delivery.**

Questionnaires at the end of each session on the topics of that day and any work based on the literature.

## Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Manuscripts and reports	30%	0	0	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12
Oral communications	40%	0	0	1, 2, 4, 5, 6, 7, 8, 11, 12
Practical and Theoretical Writing Exams	30%	0	0	1, 2, 4, 7, 8, 10, 12

## Bibliography

All recommended literature will be given during the sessions. Here some general indicators of some subjects:

**- Dendrimers and hyperbranched molecules: preparation and applications.**

1. Dendrimers: Towards Catalytic, Material and Biomedical Uses. First Edition. Anne-Marie Caminade, Cédric-Olivier Turrin, Régis Laurent, Armelle Ouali and Béatrice Delavaux-Nicot, 2011, John Wiley & Sons, Ltd. Published 2011 by John Wiley & sons, Ltd. ISBN 9780470748817

2. Dendrimer Chemistry. Fritz Vögtle, Gabriele Richardt and Nicole Werner. 2009 WILEY-VCH Verlag GMBH & Co. KGaA, Weinheim. ISBN 978-3-527-32066-0

**- Soft materials: polymeric coatings and gelators, Supramolecular structures.**

1. Introduction to Soft Matter: Synthetic and Biological Self-Assembling Materials, I. W. Hamley, Wiley 2007.

2. Polymer Chemistry, C. E. Carraher, Jr. 7th Edition. CRC Press, 2011.

**- Nanoparticle synthesis and applications in catalysis and chemical analysis.**

1. Nanoparticles. From Theory to Application. Schmid, Ed., 2nd ed., Wiley-VCH, Weinheim, 2010

2. Nanoparticles and Catalysis. D. Astruc, Ed., Wiley-VCH, Weinheim, 2008