



## Teaching Guide

| Teaching Guide           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |                       |           |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        | 2020/21               |           |
| Subject (*)              | Chemistry of Biomolecules                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        | Code                  | 610509115 |
| 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                 | GalicianEnglish                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |                       |           |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |        |                       |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |                       |           |
| Department               | Departamento profesorado másterQuímica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |                       |           |
| Coordinador              | García Romero, Marcos Daniel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | E-mail | marcos.garcia1@udc.es |           |
| Lecturers                | García Romero, Marcos Daniel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | E-mail | marcos.garcia1@udc.es |           |
| Web                      | www.usc.es/gl/centros/quimica/curso/master.html                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |                       |           |
| General description      | This subject is intended for students to acquire a thorough understanding of the structure, function and applications of the major biomolecules, mainly proteins, carbohydrates and nucleic acids. It starts from the idea that students have enough knowledge of chemistry to understand various aspects of the molecular behavior of different types of biomolecules. The course will not only deal with structural aspects and the different biological functions of biomolecules, but the study on the different synthetic strategies for their manipulation will also be addressed, as well as the techniques used to modulate and / or modify their biological activity in order to get new tools in biomedical research. |        |                       |           |
| Contingency plan         | 1. Modifications to the contents<br>No changes will be made<br>2. Methodologies<br>*Teaching methodologies that are maintained<br>*Teaching methodologies that are modified<br>All methodologies are maintained and adapted to a non-face-to-face mode and are carried out in the Moodle and Teams virtual classroom.<br>Mixed test: it will be done through the Moodle platform<br>3. Mechanisms for personalized attention to students<br>Activities will be tracked through teams, moodle and email.<br>*Evaluation observations:<br>all those reflected on the guide.<br>5. Modifications to the bibliography or webgraphy: none.                                                                                           |        |                       |           |

## Study programme competences

| Code | Study programme competences                                                                                                                                                           |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1   | Define concepts, principles, theories and specialized facts of different areas of chemistry.                                                                                          |
| A2   | Suggest alternatives for solving complex chemical problems related to the different areas of chemistry.                                                                               |
| A3   | Innovate in the methods of synthesis and chemical analysis related to the different areas of chemistry                                                                                |
| A4   | Apply materials and biomolecules in innovative fields of industry and chemical engineering.                                                                                           |
| A9   | Promote innovation and entrepreneurship in the chemical industry and in research.                                                                                                     |
| B1   | Possess knowledge and understanding to provide a basis or opportunity for originality in developing and / or applying ideas, often within a research context                          |
| 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. |
| B4   | Students should be able to communicate their conclusions, and the knowledge and the reasons that support them to specialists and non-specialists in a clear and unambiguous manner    |
| B5   | Students must possess learning skills to allow them to continue studying in a way that will have to be largely self-directed or autonomous.                                           |
| 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 |                          |
| Learning of the biogenetic rules and the function of biomolecules                                                                        |  | AC2<br>AC3<br>AC4           | BC5<br>BC10<br>BC11      |
| Acquisition of advanced knowledge in the chemistry of the most important biomolecules (proteins, nucleic acids and sugars).              |  | AC1<br>AC9                  | BC1<br>BC2<br>BC4<br>BC7 |
| Learning the more relevant aspects related to the isolation and characterization of biomolecules as well as their synthetic manipulation |  | AC2<br>AC4                  | BC2<br>BC5<br>BC7        |

| Contents                                     |                                                                                                                                                    |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                        | Sub-topic                                                                                                                                          |
| UNIT 1. Introduction and historical aspects. | Different components of the cell. Organization. Structure and function of main biomolecules                                                        |
| UNIT 2. Peptides and proteins.               | Structural aspects. Synthesis and modification. Design of functional proteins. Metalloproteins: types, methods of study, examples and applications |
| UNIT 3. Nucleic acids                        | Structure, DNA synthesis. Sequencing, PCR, DNA Recognition. DNA beyond biology: processing and storage of information; nanomaterials.              |
| UNIT 4. Carbohydrates                        | Structural aspects. Synthesis and modification. Glycoconjugates and its role in cellular communication. Glycocode. Glycotherapy                    |

| Planning                        |                         |                      |                               |             |
|---------------------------------|-------------------------|----------------------|-------------------------------|-------------|
| Methodologies / tests           | Competencies            | Ordinary class hours | Student's personal work hours | Total hours |
| Guest lecture / keynote speech  | B2 B5 C3 C4             | 12                   | 24                            | 36          |
| Problem solving                 | B4 B7 B10 B11           | 3                    | 17.5                          | 20.5        |
| Case study                      | A2 A4 C1                | 0                    | 1                             | 1           |
| Oral presentation               | B1 B4 B7 B10 B11 C1     | 4                    | 0                             | 4           |
| Mixed objective/subjective test | A1 A4 A3 A9 B1 B2<br>B5 | 1.5                  | 10                            | 11.5        |
| 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 | There will be 12 magisterial sessions in a group where the theoretical contents of the subject will be included, along with relevant illustrative examples. They will mainly consist of presentations in Power Point. Students will have a copy of all the files in Moodle, so that the students can prepare the classes in advance, as well as facilitate the follow-up of explanations. Interactive participation of students will be encouraged at all times. |



|                                 |                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Problem solving                 | It is proposed to carry out 7 sessions of problem seminars in small groups, where students will solve the problems proposed by the teacher. Students will have enough time in advance to solve the problems since those will be uploaded in Moodle before the start of these classes. During these classes any questions that may arise will also be solved. Participation in these classes is mandatory |
| Case study                      | In the seminar sessions, the case studies proposed by the teacher will also be solved. Students will have access to such cases enough time in advance through Moodle.                                                                                                                                                                                                                                    |
| Oral presentation               | The students will present works, reports, etc., orally, including discussions between the teacher and the students.                                                                                                                                                                                                                                                                                      |
| Mixed objective/subjective test | The final exam will cover all the contents of the course                                                                                                                                                                                                                                                                                                                                                 |

| Personalized attention |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Methodologies          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Problem solving        | Tutorships are programmed by the teacher and coordinated by the Center. In general, each student will have two hours per semester. During these sessions control activities such as directed exercises, clarification of doubts about the theory or problems, exercises, readings or other proposed tasks, presentations, discussions or comments will be carried out. In many cases, the teacher may require that the students submit the exercises before the celebration of the classes. These submissions will be included in the calendar of activities to be developed by the students throughout the course in the teaching guide. Participation in these classes is mandatory. |

| Assessment                      |                      |                                                                                                                                                                                                                     |               |
|---------------------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                   | Competencies         | Description                                                                                                                                                                                                         | Qualification |
| Guest lecture / keynote speech  | B2 B5 C3 C4          | The student's participation in the expositive sessions will be assessed, through questions asked by the teacher or through the discussion with the classmates.                                                      | 5             |
| Mixed objective/subjective test | A1 A4 A3 A9 B1 B2 B5 | The final exam (N2) will cover all subjects. It will weigh 55% of the final mark.                                                                                                                                   | 55            |
| Case study                      | A2 A4 C1             | Within the seminars, a series of evaluable activities will be carried out: Resolution of practical cases, written work and reports                                                                                  | 5             |
| Oral presentation               | B1 B4 B7 B10 B11 C1  | The student will present orally during the course one or more of the results obtained within the activities proposed in the seminars                                                                                | 5             |
| Problem solving                 | B4 B7 B10 B11        | It will consist of two parts: theoretical-practical classes (seminars) and interactive classes in very small groups (tutorships). Within the continuous assessment (N1) this part will weigh 30% in the course mark | 30            |

| Assessment comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>The qualification of this subject will be done through continuous assessment and the completion of a final exam. To access the exam is necessary the participation in the 100% of compulsory attendance teaching activities (classes, seminars and tutorships).</p> <p>Continuous assessment (N1) will weigh 45% in the grade of the subject and consist of two components: small interactive group classes (seminars) and interactive classes in very small groups (tutorships). Seminars and tutorships will include the resolution of problems and practical cases (40%) and oral questions and problems during the course (5%).</p> <p>The final exam (N2) will cover the entire contents of the subject and will have a value of 55%</p> <p>The student's score will be obtained as a result of the application of the following formula:</p> $\text{final note} = 0.45 \times N1 + 0.55 \times N2$ <p>N1 corresponds to the continuous evaluation (scale of 0-10) and N2 the final exam (scale of 0-10).</p> |

| Sources of information |
|------------------------|
|------------------------|

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Basic</b>         | <ul style="list-style-type: none"> <li>- Blackburn, M.; Gait, M.J.; Loakes, D.; Williams, D.M. (2006). Nucleic Acids in Chemistry and Biology. Royal Society of Chemistry</li> <li>- Vranken, D-V; Weiss, G.A. (2012). Introduction to Bioorganic Chemistry and Chemical Biology. Garland Science</li> <li>- Chris R. Calladine, Horace R. Drew, Ben F. Luisi and Andrew A. Travers (2004). Understanding DNA, The Molecule &amp; how It Works. Elsevier</li> <li>- Alberts et al (2002). Molecular Biology of the Cell. Garland Science</li> <li>- Davies, B.G.; Fairbanks. A.J. (2004). Carbohydrate Chemistry. Oxford Science publications</li> <li>- Taylor, M.E.; Drickamer, K. (2011). Introduction to Glycobiology. Oxford University press</li> <li>- Brändén, C-I; Tooze, J. (1999). Introduction to Protein Structure. Garland Science</li> <li>- Peng G. Wang, C. R. Betozzi. Marcel Dekker (2001). Glycochemistry, Principles, Synthesis and Applications..</li> <li>- Gutte, B. (1995). Peptides: Synthesis, Structures and Application. Academic Press</li> <li>- Dr. Norbert Sewald, Prof. em. Dr. Hans-Dieter Jakubke, (2009). Peptides: Chemistry and Biology. John-Wiley</li> <li>- Driguez, H; Thiem (1997). Glycoscience, Synthesis of Substrate Analogs and Mimetics.. J. Springer-Verlag</li> <li>- D. Serge (1997). The Molecular and Supramolecular Chemistry of Carbohydrates. A chemical introduction to glicoscience.. Oxford Science publications</li> </ul> |
| <b>Complementary</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

#### Recommendations

##### Subjects that it is recommended to have taken before

Advanced Structural Determination/610509103

Structure and Reactivity of Organic Compounds /610509114

##### Subjects that are recommended to be taken simultaneously

Chemistry of Natural Products/610509118

Molecular Biology/610509117

Medicinal Chemistry/610509116

##### Subjects that continue the syllabus

#### Other comments

The students should review the theoretical concepts introduced in each chapter using the reference manual and the material provided by the professor. Those students, which have significant difficulties when working the proposed activities, should contact with the professor during the tutorships, in order to analyze the problem and help solve these difficulties. It is very important when preparing the exam to solve some of the exercises from the list at the end of each chapter.

(\*)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.