Teaching Guide				
Identifying Data				2018/19
Subject (*)	Chemistry of Biomolecules		Code	610509115
Study programme	Mestrado Universitario en Investigación Química e Química Industrial (Plan 2017)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	Yearly	First	Optional	3
Language	GalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Pazos Chantrero, Elena	E-mail	elena.pazos@udc.es	
Lecturers	Pazos Chantrero, Elena	E-mail	elena.pazos@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.			

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 AC3 AC4	BC5 BC10 BC11	

Acquisition of advanced knowledge in the chemistry of the most important biomolecules (proteins, nucleic acids and sugars).	AC1 AC9	BC1 BC2 BC4 BC7	CC4
Learning the more relevant aspects related to the isolation and characterization of biomolecules as well as their synthetic manipulation	AC2 AC4	BC2 BC5 BC7	CC1 CC3

Contents	
Topic	**Sub-topic**
Chapter 1. Introduction and historical aspects.	Different components of the cell. Organization. Structure and function of main biomolecules
CHAPTER 2. Peptides and proteins. Structural aspects. Synthesis and modification. Design of functional proteins. Metalloproteins: types, methods of study, examples and applications	Amino acids and peptides. Proteins and functions. Primary, secondary, tertiary and quaternary structure. Biosynthesis. Chemical synthesis. Modification by chemical methods. Applications.
CHAPTER 3. UNIT 3. Nucleic acids: Structure, DNA synthesis. Sequencing, PCR, DNA Recognition. DNA beyond biology: processing and storage of information; nanomaterials.	Structure of the Nucleotides. Structure and function of the different nucleic acids. Supramolecular chemistry of nucleic acids. Biosynthesis. Synthesis and manipulation of nucleic acids by chemical methods. The interaction with small molecules and metal complexes.
CHAPTER 4. Carbohydrates and their derivatives. Structural and synthesis. Glycoconjugates and its role in cellular communication. Glycocode. Glycotherapy	Monosaccharides, nomenclature, structure and chemistry. Oligosaccharides and polysaccharides, nomenclature, structure. Structural determination of oligo-and polysaccharides. Biosynthesis, chemical synthesis and biological synthesis of oligosaccharides. Glycosides and glycosidase inhibitors: types, incidence in nature, methods of synthesis and biological applications. Glycolipids. Types of structures. Natural incidence. Biosynthesis. Functions. Glycoproteins. Types of structures. Natural incidence. Biosynthesis. Functions. The glycocode concept. Future prospects and scope thereof. Glycotherapy and Glycoconjugates known functions.

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 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. Active participation in these classes is not mandatory, but it is highly recommended

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 in the corresponding newsletters. Students will have enough time in advance for such newsletters through the Moodle of the subject so that they can be developed individually before the start of these classes. These classes will also resolve any questions that may arise. 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 for such cases enough time in advance through the Moodle of the subject.
Oral presentation	Oral presentation by the student of works, reports, etc., including also 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	Tutoring scheduled by the professor and coordinated by the Centre. It will be 2 hours per student and will involve the supervision of proposed work, clarifying doubts, etc. Attendance at these classes is mandatory

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Mixed objective/subjective test	A1 A4 A3 A9 B1 B2 B5	Or final exam (N2) will cover all subjects. It will weigh 55% on a subject rating.	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 development of the subject, 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 (tutorials). Within the continuous assessment (N1) this part will weigh 30% in the course mark	30
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

Assessment comments
The evaluation of this course will be done by means of the continuous assessment and completion of a final exam. Access to the exam will be conditioned on the participation in at least 80% of the mandatory classroom teaching activities (seminars and tutorials). Continuous assessment (N1) will be 45% of the qualification and the final exam (N2) will cover all the contents of the course. The student's score will result of applying the following formula: Final score = 0.45 x N1 + 0.55 x N2, N1 and N2 are the marks corresponding to the continuous assessment (0-10 scale) and the final exam (0-10 scale), respectively. The repeaters will have the same system of class attendance than those who study the course for first time.

Sources of information	
Basic	- Dr. Norbert Sewald, Prof. em. Dr. Hans-Dieter Jakubke, (2009). Peptides: Chemistry and Biology. John-Wiley - Gutte, B. (1995). Peptides: Synthesis, Structures and Application. Academic Press - Brändén, C-I; Tooze, J. (1999). Introduction to Protein Structure. Garland Science - Taylor, M.E.; Drickamer, K. (2011). Introduction to Glycobiology. Oxford University press - Davies, B.G.; Fairbanks. A.J. (2004). Carbohydrate Chemistry. Oxford Science publications - Alberts et all (2002). Molecular Biology of the Cell. Garland Science - Chris R. Calladine, Horace R. Drew, Ben F. Luisi and Andrew A. Travers (2004). Understanding DNA, The Molecule & how It Works. Elsevier - Vranken, D-V; Weiss, G.A. (2012). Introduction to Bioorganic Chemistry and Chemical Biology. Garland Science - Blackburn, M.: Gait, M.J.; Loakes, D.; Williams, D.M. (2006). Nucleic Acids in Chemistry and Biology. Rayal Society of Chemistry - Peng G. Wang, C. R. Betozzi. Marcel Dekker (2001). Glycochemistry, Principles, Synthesis and Applications.. - D. Serge (1997). The Molecular and Supramolecular Chemistry of Carbohydrates. A chemical introduction to glicoscience.. Oxford Science publications - Driguez, H; Thiem (1997). Glycoscience, Synthesis of Substrate Analogs and Mimetics.. J. Springer-Verlag
Complementary	

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
The 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 tutorials, in order to analyze the problem and to receive the necessary support.The professor will analyze with those students who do not successfully pass the evaluation their difficulties in learning. Additional material (questions, exercises, tests, etc..) to strengthen the learning of the course might be also provided.