1. BASIC INFORMATION

Course	Biochemistry
Degree program	Dentistry
School	Health Sciences
Year	First
ECTS	6
Credit type	Basic
Language(s)	English/Spanish
Delivery mode	In classroom learning
Semester	1º Semester
Academic year	2024-2025
Coordinating professor	Dr. Mariangela Tabone
Professors	Dr David Ballesteros, Dra. Maria Antonia Cid, Dr.José Aguiar, Dr. Mariangela Tabone

2. PRESENTATION

The education of future professionals is the principal goal of the University, and the subject of Biochemistry has become the foundation for understanding all biological processes in physiological conditions during development and adult life. It provides basic information about the causes of many diseases and pathologies in humans.

3. COMPETENCIES AND LEARNING OUTCOMES

Core competencies:

- CB1: That students have demonstrated to possess and understand knowledge in an area of study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply knowledge coming from the vanguard of his field of study.
- CB2: That students know how to apply their knowledge to their work or vocation in a professional manner and possess the skills that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.
- CB3: That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
- CB5: That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

Cross-curricular competencies:

- CT1: Autonomous learning: Process that allows the person to be the author of their own development, choosing the paths, the strategies, the tools and the moments that they consider

most effective to learn and independently implement what they have learned. The autonomous student, in short, selects the best strategies to achieve their learning objectives.

- CT4 - Capacity for analysis and synthesis: Analysis is the method of reasoning that allows the decomposition of complex situations in their constituent parts; also evaluate other alternatives and perspectives to find optimal solutions. The synthesis seeks to reduce complexity in order to understand it better and / or solve problems.
- CT7 - Awareness of ethical values: Ability to think and act according to universal principles based on the value of the person that are directed to their full development and that entails the commitment with certain social values.
- CT9 - Skills in interpersonal relationships: Interacting positively with other people verbally and nonverbally through assertive communication, understood by this, the ability to express or convey what you want, what you think or feel without bothering, assault or hurt the feelings of the other person.

Specific competencies:

- SC2. Know the biomedical sciences on which Dentistry is based to ensure correct oral-dental care. Among these sciences, appropriate content in Genetics, Biochemistry, Cellular and Molecular Biology have to be included.

Learning outcomes:

- LO1: Basic knowledge of biomolecules structure and function
- LO2: Background knowledge of chemical reactions in living organisms
- LO3: Importance of Biochemistry in Dentistry
- LO4: Analysis of pathological and physiological situations under a biochemical perspective
- LO5: Development of general competences useful for the future of a dentist

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

Competencies	Learning outcomes
CB1, CB3, CT1, CT4, SC2	LO1: Basic knowledge of biomolecules structure and function
CB1, CB3, CT1, CT4, SC2	LO2: Background knowledge of chemical reactions in living organisms
CB2, CB3, CB5, CT7, CT9, SC2	LO3: Importance of Biochemistry in Dentistry
CB2, CB3, CB5, CT1, CT4, CT7, SC2	LO4: Analysis of pathological and physiological situations under a biochemical perspective
CB2, CB3, CB5, CT1, CT7, CT9, CT12, SC2	LO5: Development of general competences useful for the future of a dentist

4. CONTENT

BLOCK I: INTRODUCTION AND BIOCHEMISTRY FOUNDATIONS

LESSON 1. Introduction to Biochemistry

1.1. Basic concepts in modern biochemistry. Origin of Biochemistry as an experimental science. Relationship with other sciences. Role of biochemistry within the context of biomedical sciences.

LESSON 2. Chemical Foundations of Life

2.1. Chemical components of cells.

2.1.1. Inorganic compounds. Atomic structure. Bioelements. The main chemical elements of human body. Mineral elements related to oral environment: calcium, phosphorus, magnesium and fluoride.

2.1.2. Organic compounds: Carbon and its functional groups.

2.1.3. Chemical bonds: definition and types.
2.1.3.1. Covalent bonds: Polar, Nonpolar
2.1.3.2. Non-covalent bonds: ionic, metallic, hydrogen bonds, van der Waals forces and hydrophobic interactions.

BLOCK II. STRUCTURE OF BIOLOMECULES

LESSON 3. Water.
3.1. Introduction. Structure of the water molecule.
3.2. Physical-chemical characteristics of water.
3.2.1. Water as a solvent. Solubility and precipitation concepts. Polar, nonpolar and amphipathic molecules. Concentration of a solution: percentage and molarity.
3.2.2. Cohesion, adhesion and capillarity. Surface tension.
3.3. Water ionization. Acid, Bases and Salts. Amphoteric substances
3.4. Acid-Base equilibrium: pH concept.
3.5. Weak acids and bases. Dissociation degree: constant of ionization. Conjugated Acids and bases. pH maintenance and Buffer systems. Buffers of biological interest.

LESSON 4. Proteins.
4.1. Characteristics
4.2. Amino acids: Structure and classification. Properties
4.3. Peptidic bond
4.4. Structure of proteins. Structure-function of proteins, physic-chemical factors impacting the structure and function of proteins
4.5. Classification of proteins
4.6. Biological function of proteins
4.7. Proteins that bind ligands: Reversible binding. Proteins that bind oxygen. Antigen-antibody binding.

LESSON 5. Carbohydrates.
5.1. General properties
5.2. Structural characteristics and classification.
5.3. Monosaccharides. Chiral molecules, type of isomers, Cyclic forms. Monosaccharides of biological interest.
5.4. Disaccharides. Disaccharides of biological interest. Glycosidic bond. Monocarbonilic and dicarbonilic bonds. Reducing sugars.
5.5. Polysaccharides. Classification. Function.

LESSON 6. Lipids.
6.1.General properties
6.2. Structure, properties and functions of lipids. Fatty acids
6.3. Classification I. Lipid saponification: Fat. Functions
6.4. Classification II. Non-saponification Lipids: terpenoids, Steroids, Eicosanoids. Importance of Prostaglandins.
6.5. Monolayers, bilayers and micelles.

LESSON 7. Nucleic acids.
7.1. Structural elements: nucleosides and nucleotides.
7. 1.1. Types of nucleic acids: DNA, RNA.
7.1.2. Nucleotides of biological interest with energetic function: ATP and GTP.
7.2. Structure of DNA.
7.2.1. Physical-chemical factors that affect DNA structure.
7.2.2. Packaging of DNA in eukaryotes.
7.3. Structure of RNA and different types of RNA molecules.
7.4. Functions of nucleic acids. Differences and similitudes. Cellular location.
7.5. Concept of Gene. Differences between eukaryotes and prokaryotes

BLOCK III. FUNCTION OF BIOMOLECULES

LESSON 8. Enzymes.
8.1. Definition and characteristics of enzymes
8.2. Enzymes and catalytic molecules. Enzyme kinetics
8.3. Regulation and control of enzyme activity. Inhibitors. Alosterism. Temperature and pH.
8.4. International Classification.
8.5. Cyclooxygenase and inflammatory processes

LESSON 9. Hormones. Second Messenger. Vitamins and cofactors.
9.1. Hydrosoluble and lyposoluble hormones. Structure and function.
9.2. Second messengers: Phosphatidylinositol and cAMP.
9.3. Vitamins and cofactors.
9.3.1. Hydrosoluble vitamins. Vitamin C and its effects on oral tissues. Other hydrosoluble vitamins and cofactors.
9.3.2. Liposoluble vitamins: A, D, E and K.

LESSON 10. Biochemical Composition of Biological Membranes.
10.1. Introduction. Composition and structure
10.2. Membrane dynamics
10.3. Proteins in the membrane: Proteins involved in Transport.

LESSON 11. Biochemical Composition of Extracellular Matrix.
11.1. Components. Proteins: collagen, fibronectin, laminin. Glycoconjugates: hyaluronic acid, proteoglycans and glycosaminoglycans.
11.2. Basal lamina. Degradation of extracellular matrix and basal membrane; relationship with periodontal disease.

LESSON 12. Composition and Function of Saliva
12.1. Composition.
12.1.1. Organic compounds. Proteins: mucins, statherins, proline-rich proteins, histatins and cystatins; saliva enzymes: amylase
12.1.2. Inorganic compounds. Calcium and phosphate levels
12.2. Saliva functions
12.1.1. Buffering function: acid-base equilibrium
12.1.2. Effect of low pH values on demineralization of dental enamel and cariogenic process.
12.3. Carbohydrates into the oral cavity.

BLOCK IV. METABOLISM

LESSON 13. Cellular Metabolism. Introduction.
13.1. Capture of nutrients and production of energy.
13.2. Nutrition forms: autotroph and heterotroph organisms; phototrophs and chemotrophs
13.3. Metabolic processes: nutrition, breathing and biosynthesis
13.4. Definition of Metabolism. Types of metabolism: Catabolism and anabolism.

LESSON 14. Carbohydrate Metabolism.
14.1. Catabolism
14.1.1. Glycolysis; Fermentation and oxidation: Krebs cycle and oxidative phosphorylation
14.1.2. Catabolism of polysaccharides
14.1.3. Glycogen breakdown
14.2. Anabolism
14.2.1. Gluconeogenesis
14.2.2. Glycogen synthesis.

LESSON 15. Lipid Metabolism.
15.1. Catabolism of lipids. Degradation of triglycerides
15.2. Beta-oxidation
15.3. Anabolism of lipids
15.4. Ketosis

LESSON 16. Protein Metabolism.
16. 1. Catabolism of proteins. Degradation of proteins: deamination of proteins 16.1.1. Urea Cycle
16.2. Anabolism of proteins. Essential amino acids

5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Lectures
- Integrated Laboratory work (WSLA model)
- Problem Based Learning activities
- Online activities
- Assigned reading text
- Class solution and consequence
- Case Study

6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

Campus-based mode:

Learning activity	Number of hours
Master Classes	40
Magistral classes, asynchronous way	5
Problem based Learning	5
Laboratory Practices /Integrated laboratory Practices (WSLA model)	10
Tutorial session	10
Exams	5
Autonomous study and work	75
TOTAL	**150**

7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

Campus-based mode:

Assessment system	Weight (%)
1. Theoretical Tests	70
2. Mandatory activities	10
3. Laboratory Practices /Integrated laboratory Practices (WSLA model)	20

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

It is essential that the **grade of each evaluable block is equal to or greater than** 5. The final grade of the student will be obtained from the weighting of the partial grades of each of the blocks, as indicated in the table and detailed below. In the case of not having passed any of the evaluable blocks, the final score in the academic certificate will always be the lowest one. The grades published in the virtual campus will be provisional until the review of the exam.
The evaluation methodology for the three evaluable blocks can be based on: test questions, short questions, open questions with and without extension limitation, correspondence questions, questions with embedded answers, information synthesis tables, papers, oral presentations, etc.
In the case of a modification of the evaluation date, according to the application of the rules for changing the date of evaluable tests, the format the test may vary with respect to the general call.

- **Assessment of objective knowledge tests (70%):**

Two objective tests will be carried out. Students will be able to do the second test independently if they have passed the first test.

In each of the two exams the student must obtain a grade of at least 5.0 to pass the block. Once the theoretical exams have been passed, the qualification of this block will be the weighted average of the first midterm exam and the final exams (50% + 50% respectively).

- **Assessment of mandatory activities (10%):**

The attendance to the activities, and the elaboration of requested works is mandatory to be able to pass this block. The evaluation of the activities will be done demonstrating the knowledge and skills acquired during them. In the virtual campus the evaluation modality of each one of these activities will be detailed before its realization.
The grade of the block will correspond to a weighted measure of all the included activities. It is necessary to obtain a minimum grade of 5 in this block to pass this section and be able make a weighted average with the other two blocks of the subject.

- **Assessment of laboratory practices (20%):**

Attendance at laboratory practices is mandatory in order to pass this block. The assessment of the practices will be done demonstrating the knowledge and skills acquired during the experiments carried

out in the laboratory. In the virtual campus will be detailed the evaluation modality of each of these practices.
The grade of the block will correspond to a weighted measure of all the included activities. It is necessary to obtain a minimum grade of 5 in this block to pass this section and be able to make a weighted average with the other two blocks of the subject.
When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

Regarding attendance, as stated in the evaluation regulations for official degree programs at the European University of Madrid, students taking campus-based studies are required to demonstrate that they have attended at least 50% of their classes. Such attendance forms an essential part of the assessment process and is necessary to give the student the right to receive guidance, assistance and academic supervision from the professor. For such purposes, students must use the technological system put in place by the University to accredit their daily attendance at each of their classes. This system shall furthermore ensure that objective information is gathered regarding the active role of the student in the classroom. The failure to use the methods proposed by the University to demonstrate 50% attendance will give the professor the right to grade the course as a fail under the ordinary exam period. The foregoing does not affect other requirements of higher attendance percentages that each school may establish in their teaching guides or internal regulations. Therefore, it is the authority of the professor that students who have not fulfilled the 50% of attendance in the ordinary call must pass all the evaluation tests in the extraordinary call, for which they must obtain a grade greater than or equal to 5.0 out of 10.0 in all of them.

7.1. Ordinary call

To pass the subject in the ordinary call, student must obtain a final grade (weighted average) of 5.0 or higher out of 10.0.

In any case, it will be necessary to obtain a grade of 5.0 or higher in each of the assessable blocks (exams, mandatory activities and practical classes).

If student pass both exams in the ordinary call but there are pending assignments such as practical classes and/ or mandatory activities, student can retake pending assignments in the ordinary call as indicated below:

Recovery of Mandatory Activities:
To recover mandatory activities in the ordinary call, in addition to passing both exams, student must have completed at least half of the mandatory activities originally proposed.
Students must complete and pass all mandatory activities that were not completed before.

Recovery of Practical Activities:
To recover practical activities in the ordinary call, in addition to passing both exams, student must have completed at least three practical activities at the time they were assigned.
A test covering all practical activities need to be passed.

7.2. Extraordinary call

To pass the subject in the extraordinary call, student must obtain a final grade of 5 out of 10 (weighted average).

In any case, it will be necessary to obtain a grade of 5.0 or higher in each of the assessable blocks (exams, mandatory activities and practical classes).

To retake the mandatory activities, the student must complete and pass the mandatory activities not successfully completed in the ordinary call. To retake practical activities, a test of all the practices needs to be passed.

8. SCHEDULE

This table shows the delivery deadline for each assessable activity in the course:

Assessable activities	Deadline
Introduction to the Laboratory work: risks, wastes and materials management	Week 2-4
pH and physiological buffer systems	Week 5-6
Mandatory activity nº 1: Structure and Function of Hemoglobin	Week 5
Mandatory activity nº 2:	Week 7
First exam	Week 8
Study of structural and functional alterations of the formed elements (cells) of blood.	Week 8-10
Genomic DNA extraction and DNA amplification by PCR	Week 11-12
Metabolism	Week 13
Mandatory activity n º3	Week 17
Mandatory activity nº 4	Week 18
Final Exam	Week 19

This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

9. BIBLIOGRAPHY

Here is the recommended bibliography:

- FEDUCHI E. y cols. Bioquímica. Conceptos esenciales.2ª Ed. Panamericana, 2015.
- - LEHNINGER, Principios de Bioquímica, 6ª ed. D.L.Nelson y M. M. Cox. Editorial Omega, 2013.
- - STRYER, BERG, TYMOCZKO, Bioquímica. 7ª Ed. Reverte, 2014
- -KOOLMAN y RÖM. Bioquímica humana. Texto y atlas. 4ª ed. Ed Panamericana, 2012
- - MATHEWS C.K. et al. Bioquímica. 4ª ed. PEARSON, 2013.
- - VOET D, VOET J.G. Bioquímica. 4ª Ed.Panamericana, 2011.
- - HORTON H. R. y cols. Principios de bioquímica. 4ªed. Prentice Hall (2007).

- - McKEE, T. y McKEE, J.R. Bioquímica. La base molecular de la vida. 3ªed. McGraw Hill-Interamericana 2003. Material didáctico en inglés en www.mhhe.com/mckee
- - RAMOS ATANCE, J. A. Bioquímica Bucodental. Ed. Síntesis 1999.
- -BioROM 2011: Ayudas a la enseñanza y el aprendizaje de la Bioquímica y Biología Molecular (Material multimedia en CD-ROM). Publicado por Sociedad Española de Bioquímica y Biología Molecular.
- -W.J. MARSHALL, S.K. BANGERT Y M. LAPSLEY. Bioquímica clínica, 7ª Ed. 2013.
- - http://www.ncbi.nlm.nih.gov/books/?term=Biochemistry

10. EDUCATIONAL GUIDANCE AND DIVERSITY UNIT

From the Educational Guidance and Diversity Unit we offer support to our students throughout their university life to help them reach their academic achievements. Other main actions are the students inclusions with specific educational needs, universal accessibility on the different campuses of the university and equal opportunities.

From this unit we offer to our students:

1. Accompaniment and follow-up by means of counselling and personalized plans for students who need to improve their academic performance.
2. In terms of attention to diversity, non-significant curricular adjustments are made in terms of methodology and assessment for those students with specific educational needs, pursuing an equal opportunities for all students.
3. We offer students different extracurricular resources to develop different competences that will encourage their personal and professional development.
4. Vocational guidance through the provision of tools and counselling to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa@universidadeuropea.es

11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.