COURSE DATA

Data Subject	
Code	36456
Name	Biochemistry
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	4	First term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	10 - Biochemistry	Obligatory

Coordination

Name	Department
CASINO FERRANDO, PATRICIA	30 - Biochemistry and Molecular Biology

SUMMARY

The course "Biochemistry" is included within the module "Basic Chemistry" and is compulsory. It has 6 ECTS taught in the fourth year. The main objective of the course is to provide students with basic knowledge about the functioning of living beings at the molecular level. For this, the structure and function of biological macromolecules will be studied, to get to understand their capabilities of specific interaction, catalysis, signaling and maintenance and transfer of information. The molecular basis of development and transformation of energy by living organisms will also be discussed, and the main routes of metabolism and its regulation will be addressed with an integrated perspective.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

1110 - Degree in Chemistry V2-2018 :

1929 - Double Degree in Physics and Chemistry :

1934 - Programa de doble Grado Química-Ingeniería Química_2023 :

R4-OBLIGATION TO HAVE SUCCESSFULLY COMPLETED THE COURSE

34191 - Biology

34191 - Biology

34191 - Biology

Other requirements

OUTCOMES

1110 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Learn autonomously.
- Demonstrate the ability to adapt to new situations.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry.
- Ability to recognise chemical elements and their compounds: preparation, structure, reactivity, properties and applications.
- Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.
- Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.

- Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Recognise and analyse new problems and plan strategies to solve them.
- Evaluate, interpret and synthesise chemical data and information.
- Handle chemicals safely.
- Handle the instrumentation used in the different areas of chemistry.
- Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them.
- Evaluate the risks in the use of chemicals and laboratory procedures.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- Relate chemistry with other disciplines.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

LEARNING OUTCOMES

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter BIOCHEMISTRY that allow to acquire specific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject BIOCHEMISTRY related to the competences of the degree in Chemistry.

SPECIFIC KNOWLEDGE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject BIOCHEMISTRY that contemplate the learning outcomes EUROBACHELOR®
The principal techniques of structural investigations, including spectroscopy	Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes..(CE12). Handle the instrumentation used in the different areas of chemistry.(CE19). Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.(CE8)
The principles of thermodynamics and their applications to chemistry	Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry..(CE6).
The kinetics of chemical change, including catalysis; the mechanistic interpretation of chemical reactions	Demonstrate knowledge of the principles of thermodynamics and kinetics and their applications in chemistry..(CE6).
The properties of aliphatic, aromatic, heterocyclic and organometallic compounds.	Demonstrate knowledge of the main types of chemical reaction and their main characteristics.(CE4) Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.(CE8). Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes..(CE12).

The nature and behaviour of functional groups in organic molecules	Demonstrate knowledge of the main types of chemical reaction and their main characteristics.(CE4) Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.(CE8).
Major synthetic pathways in organic chemistry, involving functional group interconversions and carbon- carbon and carbon-heteroatom bond formation	Demonstrate knowledge of the main types of chemical reaction and their main characteristics.(CE4) Demonstrate knowledge of the principles, procedures and techniques for the determination, separation, identification and characterisation of chemical compounds.(CE8). Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes..(CE12).
The relation between bulk properties and the properties of individual atoms and molecules, including macromolecules (both natural and man-made), polymers and other related materials.	Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.CE11).
The structure and reactivity of important classes o biomolecules and the chemistry of important biological processes	Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes..(CE12). Relate chemistry with other disciplines.(CE26).

COMPETENCES AND COGNITIVE SKILLS	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject BIOCHEMISTRY that contemplate the learning outcomes EUROBACHELOR®

Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry..(CE13).
Ability to apply this knowledge and understanding to the solution of common qualitative and quantitative problems.	Solve qualitative and quantitative problems following previously developed models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Competences for the evaluation, interpretation and synthesis of information and chemical data.	Evaluate, interpret and synthesise chemical data and information..(CE16). Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20).
Ability to calculate and process data, related to information and chemistry data.	Solve qualitative and quantitative problems following previously developed models..(CE14). Recognise and analyse new problems and plan strategies to solve them..(CE15).

COMPETENCES AND COGNITIVE SKILLS RELATED TO THE PRACTICE OF CHEMISTRY	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject BIOCHEMISTRY that contemplate the learning outcomes EUROBACHELOR®
Capacities to handle chemical products safely, taking into account their physical and chemical properties, including any risk associated with their use.	Handle chemicals safely..(CE17). Evaluate the risks in the use of chemicals and laboratory procedures..(CE21).

Capabilities necessary to perform standard laboratory procedures as well as to use instrumentation in synthetic and analytical works, in both cases in relation to both organic and inorganic systems.	Carry out standard experimental procedures involved in synthetic and analytical work, in relation to organic and inorganic systems..(CE18).
	Relate theory and experimentation..(CE22).
	Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Capacities to monitor, observe and measure the chemical properties, facts or changes, and perform their registration (collection) and documentation in a systematic and reliable way.	Handle the instrumentation used in the different areas of chemistry.(CE19). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Ability to interpret data derived from observations and laboratory measurements in terms of their relevance, and relate them to the appropriate theory.	Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them..(CE20). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24). Relate chemistry with other disciplines.(CE26).
Ability to perform risk assessments of the use of chemical substances and laboratory procedures.	Understand the qualitative and quantitative aspects of chemical problems..(CE24). Develop sustainable and environmentally friendly methods.(CE25). Evaluate the risks in the use of chemicals and laboratory procedures..(CE21).

GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	Competences of the subject BIOCHEMISTRY that contemplate the learning outcomes EUROBACHELOR®
Ability to apply practical knowledge to solve problems related to qualitative and quantitative information.	Solve problems effectively..(CG4). Solve qualitative and quantitative problems following previously developed models..(CE14). Relate theory and experimentation..(CE22). Recognise and evaluate chemical processes in daily life..(CE23). Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Competences in information management, in relation to primary and secondary sources, including information retrieval through on-line searches.	Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate..(CG6). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).
Ability to analyse materials and synthesize concepts.	Develop capacity for analysis, synthesis and critical thinking.. (CG1). Show inductive and deductive reasoning ability..(CG2).
Ability to adapt to new situations and make decisions.	Recognise and analyse new problems and plan strategies to solve them..(CE15).
Skills related to information technology such as word processing, spreadsheet, recording and storage of data, internet use	Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information

related to the subjects.	technology, as appropriate..(CG6). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).
Interpersonal skills to interact with other people and get involved in team work.	Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5). Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7). Demonstrate the ability to adapt to new situations..(CG9).
Competences in oral and written communication, in one of the main European languages, in addition to the language of the country of origin.	Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community. (CT1). Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences..(CB4). Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).
Study skills necessary for professional development. These will include the ability to work autonomously.	Learn autonomously.(CG8). Demonstrate the ability to adapt to new situations..(CG9). Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.(CB5).

On completing this course in “Biochemistry”, students will have acquired the following skills and abilities:

1. Demonstrate knowledge of biochemical terminology (monomeric and polymeric sugars, lipids, amino acids and proteins, nucleotides and nucleic acids, enzymes, metabolic intermediates, signalling networks and metabolic networks).
2. Demonstrate knowledge of the principles of thermodynamics and kinetics and biochemical implications, particularly in terms of understanding the stability of the structures of biological macromolecules, energy metabolism and enzymatic catalysis.
3. Recognize the different biological molecules as well as the principles of their biosynthesis, structure, reactivity, properties, functions and applications.
4. Demonstrate knowledge of the principles, procedures and techniques necessary for the identification, separation, and characterization of biochemical compounds.
5. Relate macroscopic properties to properties of individual atoms and molecules, especially for biological macromolecules and supra-molecular complexes.
6. Demonstrate knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes.
7. Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to Biochemistry.
8. Solve qualitative and quantitative Biochemical problems.
9. To recognize and analyse new problems Biochemical and plan strategies to solve them.
10. Understand and use literature and technical information concerning biochemical compounds.
11. Demonstrate ability to safely handling biological samples for analytical purposes or preparations in plant laboratories.
12. Managing Biochemicals instrumentation commonly used in laboratories.
13. Interpret data from laboratory observations and measurements in terms of their significance and the theories that underpin them.
14. Assess the risks of using chemical and biological samples, as well as the risks associated with laboratory procedures.
15. Linking theory and experimentation.
16. To recognize and value the biochemical processes in daily life.
17. Understand the qualitative and quantitative aspects of biochemical problems.
18. Design, select and/or develop efficient chemical products and processes (SDG 7) that minimize their impact on the environment (SDG 14 and 15), take advantage of alternative raw materials and generate less waste (SDG 11).
19. Explain understandably phenomena related to Biochemistry and Biological Chemistry from a gender perspective.
20. Demonstrate knowledge of the theoretical foundations that allow understanding the behavior of biological systems in terms of chemical processes.

DESCRIPTION OF CONTENTS

1. Part I. Structure and function of biomacromolecules.

1. Introduction to Biochemistry. Structure and properties of water. Weak interactions in aqueous medium: Importance for solubility, structure, dynamics and interactions between biological macromolecules.

2. Aminoacids. Peptide bond. Primary and secondary structures of proteins.

3. Three-dimensional structure of proteins. Protein folding and protein denaturation.

4. Physico-chemical properties of proteins. Isolation, purification and characterization of proteins.

5. Protein-ligand interactions. Cooperativity and allosterism: the case of hemoglobin.

6. Enzymatic catalysis. Transition state theory. Kinetics of enzymatic reactions: Michaelis-Menten model. Enzyme inhibition.

7. Molecular mechanisms of enzymatic regulation. Industrial applications of enzymes.

8. Biological membranes. Structure and properties of the lipid bilayer. Membrane proteins. Signal transduction.

2. Part II. Structure and function of nucleic acids

9. Structures of DNA and RNA. Organization of genes and genomes.

10. DNA replication.

11. Transcript. Post-transcriptional processing.

12. The genetic code. Translation. Maturation, localization and degradation of proteins.

13. Analysis and manipulation of nucleic acids. Biotechnological applications

3. Part III. Bioenergetics and Metabolism

14. Biochemistry of ATP. Energy sources and strategies for generating ATP. Chemiosmotic theory and ATP synthase.

15. Respiratory chain. Oxidative phosphorylation.

16. Photoelectron transport chain. Photophosphorylation.

17. Panorama and organization of intermediary metabolism.

18. Origin and destination of acetyl-CoA. Citric acid cycle.

19. Carbohydrate metabolism, as an example metabolic pathway.

20. Integration and regulation of metabolism.

4. Lab classes

1. Structural databases. Modeling, interpretation and analysis of protein structures.

2. Assay of the enzymatic activity of alkaline phosphatase. Determination of kinetic parameters. Effects of inhibition on the kinetic parameters.

3. Preparation and analysis of plasmidic and genomic DNA.

4. Metabolism of carbohydrates. Alcoholic fermentation. Quantification of liver glycogen.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	41,00	100
Laboratory practices	12,00	100
Tutorials	7,00	100
Study and independent work	90,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Master classes
36 hour lessons, in which the Professor presents the most relevant content of the course using audiovisual media. The presentations will be published on Virtual Classroom.

Tutorials
7 sessions will be held throughout the course, intercepted with lectures, usually at the end of each of the parts of the program. In these sessions the student participation through the resolution of questions and problems will be stimulated. Before the sessions, the Professor may request delivery of solved problems. Self-assessment tests will also be performed.

Practicals
Assistance to the four practical sessions is mandatory. They will be held in 4 sessions of 3 hours (3 in laboratory and 1 in a computer classroom). Students are given in advance a booklet containing the script of the sessions, with a small theoretical introduction and a detailed protocol. The alumni should prepare each practical in advance and answer a short questionnaire before each session. After each practice, the students will present the results by filling a second questionnaire.

EVALUATION

Evaluation Method. First call:
The grade needed to pass the course will have to be equal or larger than 5 (overall rating of 10). Furthermore, each of the two parts of the course: Theory and Practice, needs also to be passed independently, in accordance with the following criteria.

Evaluation of the theoretical contents:

- A final exam of the subject will be made, in which the mark obtained will represent up to 80% of the overall rating (up to 8.0 points out of 10).
- A necessary condition to pass the Theory exam is to obtain at least 4 points.
- In the event that Theory is passed, but not the subject as a whole, the note of theory will remain until the second call. In no case will the note of theory remain for subsequent courses.

Assessment of practical classes and computer lab:

- They represent up to 20% (up to 2.0 points) of the overall grade for the course.
- For evaluation, the following will be taken into account. On the one hand, the work made previous to each practical, the implementation, and the results of each practical (Part 1) will be valued with a maximum of 1 point. On the other hand, the result of a written test about all practicals (Part 2) will be valued with a maximum of 1 point.
- The practicals are passed when the note of each of the two Parts just mentioned is at least 0.4 points (40% of its maximum value) and the total note for practicals is at least 1 point (50% of its maximum value).
- In the event that the practicals are passed, but not the subject as a whole, the note corresponding to practicals will be hold for the next call and even for the next year.

Evaluation of second call
It will be the result of single test, in which the theoretical (maximum 8 points) and practical contents (1 point maximum) will be evaluated. In the event that any of these two parts (Theory or Practicals) was passed in the first call, it will not be mandatory to repeat it in the second call, since the corresponding passed note can be applied automatically. The minimum conditions necessary to pass on second call are the same as those set up for the first call.

REFERENCES

Basic

- PERETÓ, J., SENDRA, R., PAMBLANCO, M. y BAÑÓ, C. Fonaments de bioquimica. 5ª ed. Valencia: Servei de Publicacions de la Universitat de València, 2005 (traducción al castellano, 2007). ISBN: 9788437062686.
- TYMOCZKO, J.L., BERG, J.M., STRYER, L. Bioquímica. Curso Básico. Traducción de la 2ª ed. Barcelona: Editorial Reverté, 2014. ISBN-10: 8429176039

- NELSON, D.L. y COX, M.M. Lehninger. Principios de Bioquímica. 6ª ed. Barcelona: Ed. Omega, 2014. ISBN: 978-84-282-1603-6.
- MCKEE, T. y MCKEE, J.R. Bioquímica. Las Bases Moleculares de la Vida. Mexico: MacGraw Hill Interamericana Editores, 4ª ed., 2009. ISBN: 9788448605247.

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- ALBERTS, B. Biología Molecular de la Célula. 5ª ed. Barcelona: Ed. Omega, 2010. ISBN: 978-84-282-1507-7.
- MATHEWS, C.K., VAN HOLDE, K.E. Y AHERN K.G. Bioquímica. 4ª ed. Madrid: Pearson, 2013. ISBN-13: 9788490353929