COURSE DATA

Data Subject	
Code	34208
Name	Biochemistry and biological chemistry
Cycle	Grade
ECTS Credits	6.0
Academic year	2017 - 2018

Study (s)

Degree	Center	Acad. year	Period
1108 - Degree in Chemistry	Faculty of Chemistry	3	Second term

Subject-matter

Degree	Subject-matter	Character
1108 - Degree in Chemistry	10 - Biochemistry and biological chemistry	Obligatory

Coordination

Name	Department
SALGADO BENITO, JESUS	30 - Biochemistry and Molecular Biology

SUMMARY

Biochemistry and Biological Chemistry is a compulsory 6 ECTS credit course included in the Basic Chemistry module and taught during the third academic year. The main aim of the course is to provide students with basic knowledge of the functioning of living beings at the molecular level. Students analyse the structure and function of biological macromolecules and gain an understanding of their capabilities for specific interaction, catalysis, signaling and maintenance and transfer of information. They also analyse the molecular basis for the development and transformation of energy by living organisms and the main routes of metabolism and their regulation from an integrated perspective.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is recommended to have taken and successfully passed all the subjects in the previous courses.

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

1108 - 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 (RD 1393/2007) // NO CONTENT (RD 822/2021)

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). (CE1, CT1).
2. Demonstrate knowledge of the principles of thermodynamics and kinetics and their biochemical implications, particularly in terms of understanding the stability of the structures of biological macromolecules, energy metabolism and enzymatic catalysis. (CG2, EC6).
3. Recognize the different biological molecules and the principles of their biosynthesis, structure, reactivity, properties, functions and applications. (EC7).
4. Demonstrate knowledge of the principles, procedures and techniques needed to identify, separate,

and characterise biochemical compounds. (CE8).
5. Relate macroscopic properties to the properties of individual atoms and molecules, especially for biological macromolecules and supra-molecular complexes. (CG1, CG2, CE11).
6. Demonstrate knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes. (EC12).
7. Demonstrate knowledge and understanding of essential biochemistry-related facts, concepts, principles and theories. (CG1, CG2, CE13).
8. Solve qualitative and quantitative biochemical problems. (CG2, CG5, CG8, CE14).
9. Recognize and analyse new biochemical problems and plan strategies for solving them. (CG1, CG2, CG5, CG8, CG9, CE15).

10. Understand and use literature and technical information on biochemical compounds. (CG7, CG5, CE16, CT3).

11. Demonstrate the ability to safely handle biological samples for analytical purposes or preparations in plant laboratories. (CE17).

12. Manage biochemical instrumentation commonly used in laboratories. (CE19).

13. Interpret data from laboratory observations and measurements in terms of their significance and the theories that underpin them. (CG1, CG2, CG5, CE20).

14. Assess the risks associated with using chemical and biological samples and those associated with laboratory procedures. (CE21).

15. Link theory to experimentation. (CG1, CG2, CG5, CE22).

16. Recognize and appreciate biochemical processes in our daily lives. (CE23).

17. Understand the qualitative and quantitative aspects of biochemical problems. (CG2, CG5, CE24).

18. Develop sustainable and environmentally friendly methods. (CE25).

19. Clearly explain phenomena related to Biochemistry and Biological Chemistry from a gender perspective. (CG1, CG2, CE13).

20. Demonstrate knowledge of the theoretical foundations that explain the behaviour of biological systems in terms of chemical processes. (CG1, CG2, CE26)

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

5. Enzymatic catalysis. Transition state theory. Kinetics of enzymatic reactions: Michaelis-Menten model. Enzyme inhibition.
6. Molecular mechanisms of enzymatic regulation.
7. Biological membranes. Structure and properties of the lipid bilayer. Membrane proteins. Signal transduction.
8. Structures of DNA and RNA. Organisation of genes and genomes.
9. DNA replication.
10. Transcript. Post-transcriptional processing.
11. The genetic code. Translation. Maturation, localisation and degradation of proteins.

2. Part II. Bioenergetics and Metabolism

12. The biochemistry of ATP. Energy sources and strategies for generating ATP. Chemiosmotic theory and ATP synthase.
13. Respiratory chain. Oxidative phosphorylation.
14. Photoelectron transport chain. Photophosphorylation.
15. Panorama and organisation of intermediary metabolism.
16. Origin and destination of acetyl-CoA. Citric acid cycle.
17. Carbohydrate metabolism as an example metabolic pathway.
18. Integration and regulation of metabolism.

3. Lab classes

1. Structural databases. Modelling, 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

Lectures

The lecturer uses audiovisual media to present the most important course contents in 36 one-hour lectures. The presentations will also be published in the Virtual Classroom.

Tutorials
Eight tutorials will be held during the course. These tutorials, alternating with the lectures and usually taking place on completion of each part of the program, encourage students to participate by solving numerous issues and problems. Before each tutorial the lecturer may ask students to submit their solutions to the issues and problems. Students will also be required to complete self-assessment tests.

Practical sessions
Four three-hour practical sessions will be held during the course (3 in the laboratory and 1 in a computer room). Attendance at these sessions is compulsory. Before the sessions begin, students will be provided a booklet containing the script for each session, a small theoretical introduction, and a detailed protocol. Students should prepare each practice session in advance and answer a short questionnaire beforehand. At the end of each session, students will complete a second questionnaire to present their results.

EVALUATION

Evaluation procedure. First call:
The minimum grade needed to pass the course is 5 (out of 10). In addition, students must pass each of the two parts (Theory and Practice) independently in accordance with the following criteria:

Theory:

- There will be one final examination. This examination represents up to 80% of the overall grade (i.e. up to 8 points out of the 10 available).
- Students must obtain a score of at least 4 points on this theoretical examination.
- Students who pass the theoretical examination but not the subject as a whole will have their theoretical examination scores carried over for the second call. However, in no case will these theoretical examination scores be carried over to subsequent academic years.

Practical classes and computer laboratory:

- Practical classes and computer laboratory represent up to 20% of the overall grade (i.e. up to 2 points out of the 10 available).
- Evaluation will take into account: the work students carry out before each practical, their implementation of these practical sessions, and their results on these practical sessions, up to a maximum of 1 point (part 1); a written practical examination also up to a maximum of 1 point (part 2).
- To pass this section of the evaluation, students need to score at least 0.4 points (4 out of 10) on both part 1 and part 2 above and a total score of at least 1 point (5 out of 10) overall.
- Students who pass the practical classes and computer laboratory but not the subject as a whole will have their practical classes and computer laboratory scores carried over for the second call. These scores will also be carried over to subsequent academic years if necessary.

Evaluation procedure. Second call:
A single examination will be held for the second call consisting of theoretical contents (maximum of 8 points) and practical contents (maximum of 1 point). Students who pass either of these two parts (Theory or Practical sessions) at the first call do not need to repeat that part at the second call since their score can be carried over automatically. The minimum conditions needed to pass the second call are the same as those 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.

Additional

- 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