COURSE DATA

DATA SUBJECT

Code: 36832
Name: Biochemistry
Cycle: Undergraduate Studies
ECTS Credits: 10.5
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1106 - Degree in Biology	Facultat de Ciències Biològiques	2	Annual

SUBJECT-MATTER

Degree	Subject-matter	Character
1106 - Degree in Biology	Bases moleculares y genéticas de los seres vivos	COMPULSORY

COORDINATION

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SUMMARY

The subject of "Biochemistry" is included within the field of "Molecular and Genetic basis of living organism", which is compulsory in the degree in Biology. This course has 27 credits ECTS offered in the second year of the career, through two annual courses: "Biochemistry" (10,5 ECTS) and "Genetics" (10,5 ECTS), and a third-year subject: "Molecular Methods in Biology" (6 ECTS).

The main objective of the subject of "Biochemistry" is to provide to the students with basic knowledge about the structure and function of biomacromolecules, about the different forms of the energy used by living organisms, and about the central metabolism and its regulation studied from an integrated point of view.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

1106 - Degree in Biology

Apply principles of physics, chemistry and geology to the field of biology.

Design and conduct experiments by using scientific techniques and instruments appropriately and complying with laboratory safety regulations.

Interpret, analyse, evaluate, process and synthesise biological data and information by applying mathematical and statistical methods.

Organise, plan and manage information in a manner that allows the individual to analyse, synthesise and develop critical reasoning that can be applied to solve problems, make decisions and carry out work.

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 acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Understand and relate the structure and function of biomolecules and interpret the functioning of the mechanisms of replication, transcription, translation and mutation. Be familiar with the techniques, methodologies and basic instruments of the molecular biology laboratory.

Understand the fundamentals of enzyme catalysis, the biological processes of energy production and transformation, metabolic pathways and their regulation.

Use scientific language, both oral and written, and be able to adapt the register to the target audience and/or readers. Use the most common foreign languages in each discipline as a vehicle for communication in a globalised system.

DESCRIPTION OF CONTENTS

1. Introduction

Item 1. Introduction. Biochemistry and its relationship to other sciences. Chemical composition

and characteristics of living matter. Structure and properties of water. The weak interactions in aqueous media.

2. Structure and function of proteins (Block 1)

Item 2: Structure of the proteins. Aminoacids. The peptide bond and the primary structure. Secondary structure. Tertiary structure and quaternary structure: Domains. Fibrous proteins and globular proteins. Folding and denaturizing of proteins.

Item 3: Dynamics of proteins. Functional classification of proteins. Binding of ligands. Cooperativity and allosterism. Study of the myoglobin and the hemoglobin.

3. Enzymology (Block 2)

Item 4: Chemical nature of enzymes. Active center. Enzyme specificity. Classification and nomenclature of enzymes. Enzymatic catalysis. Cofactors.

Item 5: Enzyme kinetics. Model of Michaelis-Menten. The effect of pH and temperature. Enzyme inhibition.

Item 6: Molecular mechanisms of enzymatic regulation. Regulation of enzyme concentration. Allosterism. Covalent modification of enzymes. Amplification of signals.

4. Structure and function of nucleic acids (Block 3)

Item 7: Structure and organization of the nucleic acids. Informational metabolic processes. Primary structure. Secondary structure: Model of Watson and Crick. High order structures; the circular and supercoiled DNA. Organization of the genomes and structure of the genes.

Item 8: Molecular mechanisms of the genetic information flux. DNA polymerases; enzymology of elongation of the polynucleotide chain. Enzymology of RNA synthesis. Mechanism of transcription. The genetic code. The mechanism of translation.

Item 9: Genomics and proteomics. Methods for the analysis of nucleic acids and proteins. Study of evolutionary relationships through the structure of biomacromolecules.

5. Bioenergetics (Block 4)

Item 10: ATP-ADP system. Thermodynamics of life. Biochemistry of ATP. Coupling between endergonic and exergonic reactions. Energy sources and strategies for the generation of ATP.

Item 11: Biomembranes and transport. Composition, structure and properties of biological

membranes. Thermodynamics of the transport across the membrane. Classification of transport systems. Chemiosmotic theory and ATP synthase.

Item 12: The respiratory chain. Function of the respiratory chain. Thermodynamics of the redox reactions. Classes of electron carriers: structure, organization and process. Oxidative phosphorylation. Respiratory control. Inhibitors and uncouplers.

Item 13: The photosynthetic chain. Function of the photosynthetic chain. Photosynthetic pigments. Photosystems. Organisation and process of the electron carriers. Photophosphorylation.

6. Intermediary metabolism (Block 5)

Item 14: Overview of intermediary metabolism. Organization of the metabolism. Catabolism and anabolism. Characteristics of the metabolic pathways and their regulation. Steps of the degradation of carbohydrates, lipids and proteins.

Item 15: The acetyl-CoA and the citric acid cycle. The citric acid cycle. Origin and destiny of the acetyl- CoA. The citric acid cycle: enzymatic steps. Regulation of the citric acid cycle. Amphibolic and anaplerotic character of the citric acid cycle.

Item 16: Metabolism of carbohydrates. Glycolysis: enzymatic steps and its regulation. Destinations of the pyruvate. Gluconeogenesis: enzymatic steps and its regulation. Coordinated regulation of glycolysis/ gluconeogenesis by hormones. The Cori cycle. The glyoxylate cycle. The glycogen metabolism and its regulation. The pathway of the pentose phosphates. The Calvin cycle: autotrophic CO2 fixation. Photorespiration.

Item 17: Metabolism of lipids. Digestion, absorption and transport of the triglycerides and the lipoproteins. Mobilization of lipid storages. Degradation of fatty acids: beta-oxidation. Synthesis of fatty acids. Coordinated regulation of lipid metabolism. Synthesis and uses of ketone bodies.

Item 18: Metabolism of the nitrogen-containing compounds. Oxidative degradation of amino acids. Nitrogen excretion. Nitrogen cycle in the biosphere. Nitrogen fixation. Biosynthesis of amino acids. Nucleotide metabolism.

Item 19: Integration of metabolism. Overview of the metabolism. Metabolic patterns on tissues and organs. Hormonal control of the energy metabolism. Metabolic adaptations: fasting-feeding cycle, diabetes, exercise.

7. Problems of Biochemistry

1. pH buffer solutions (3 sessions of 1h)
2. Enzyme kinetics (3 sessions of 1h)
3. Bioenergetics (3 sessions of 1h)

8. Laboratory practices

6 sessions of 3h
1. Preparation of buffer solutions: Checking the buffering capacity. Study of protein solubility as a function of the pH. Isoelectric point.
2. Separation of proteins by ion exchange and size exclusion chromatographies. Electrophoretic separation of proteins: Cellulose acetate and SDS-PAGE.
3. Enzymatic activity assay of the alkaline phosphatase. Determination of kinetic parameters. Effect of an inhibitor on the kinetic parameters.
4. Preparation of DNA and electrophoretic analysis of a plasmid with restriction enzymes
5. Effect of the wavelength on the reducing capacity of the chloroplasts.
6. Metabolism of carbohydrates. Alcoholic fermentation. Quantification of liver glycogen.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	6,00
Theory	72,00
Laboratory	18,00
Classroom practices	9,00
Total hours	**105,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	12,00
Independent study and work	145,50
Preparation of lessons	0,00
Preparation for assessment activities	0,00
Resolution of case studies	0,00
Total hours	**157,50**

TEACHING METHODOLOGY

The development of the course is divided into:

Theory lectures and questions

They consit of about 60 one-hour classroom sessions (approximately 2-3 sessions per week), in which the "master class" format will basically be used. The professor will show the most relevant information of the subject mainly using audiovisual media. The documents needed to follow the lectures will be published in the Aula Virtual.

Between these sessions, interspersed with theory classes, generally at the end of each of the blocks of the program, classes of questions are taught (may be up to 5 in each quarter).These sessions will encourage to the student participation through the resolution of questions. Before any of the sessions, the professor may request some written question resolved. This activity will reveal how students assimilate concepts and, thus, to better evaluate the student work.

Sessions of problems

Nine sessions of one-hour length will be provided throughout the course: 6 sessions in the first four- month period and 3 in the second four-month period. The last session of each period will be used to solve a written test in the classroom. A list of problems with the results will be provided. In addition, at the Aula Virtual will be available explanations of theoretical knowledge to solve model problems as well as some solved examples. The professor may request the delivery of any of the problems solved.

Sessions of laboratory

The attendance is mandatory. There will be 6 sessions of 3 hours length (4 in the first four-month period and 2 in the second four-month period). The students will have before the session a notebook containing the script for the sessions, with a small theoretical introduction and a detailed protocol of the session.

The students should prepare at home the session and to response to a brief questionnaire, provided before each session, that it must be submitted on the day of the session.

Supervised tutorials sessions

There will be 6 tutorial sessions (3 in each four-month period), with groups of 16 students where the professor will resolve questions about the content of the course (theory, problems and laboratory). These sessions may also be used for the resolution of additional questions on the topics taught

Interdisciplinary work: conducting and presenting a seminar.

The activities of the subject are completed and complemented with the transversal activity "Interdisciplinary Seminars" directly focused on the work on competences. This is a cross-disciplinary activity common to all subjects in the second year of the degree in Biology (Histology, Evolutionary Processes and Mechanisms, Zoology II, Botany II, Biochemistry, Genetics, Paleontology, Developmental Biology, and Biostatistics). It consists of the preparation and presentation, by a working group (3 students), of a seminar, which will consist of a written text and an oral presentation. The activity is compulsory for all students enrolled in the second year, except for those who have done it before. Each working group prepares a seminar on a topic proposed by the teachers of the participating subjects. The assignment of each group to the subjects will be randomly done. Each interdisciplinary work will thus be linked to the corresponding subject resulting from the draw. A tutor will be assigned to each of the projects, who will supervise the completion of the project and supervise its presentation. To this end, a series of regular meetings will be held with the tutor throughout the course. A co-tutor will also be assigned, who will review the final version of the work submitted. Each paper will be presented orally by all members of the group for 30 minutes. The presentation will be attended by all students on the course, as attendance is compulsory, and by two lecturers: the tutor and a second lecturer. Both students and teachers will take part in the

presentation.

Attendance to the conferences and other activities

The student must attend conferences and other activities that will be programmed throughout the course. Subsequently, the students can submit a summary related to the subject.

Reading and summarize a general book

The student can read a scientific book, related to the subject of Biochemistry, among those proposed by the teachers. Subsequently, students can submit a reading file, following the model available in the Aula Virtual.

EVALUATION

The evaluation will be done along the course. It will combine the assessment resulting from direct contact with each student during lectures and tutorials sessions, with the appropriate resolution of writing questions and those proposed during lectures, with the work carried out by students and with examinations marks. To pass the course, it will be necessary to obtain an overall rating equal to or greater than 5 out of 10, having passed each of the parts: theory, questions and practices. The qualifications of questions, laboratory, interdisciplinary work, class participation, and reading and review of popular books will be added once past the contents of theory.

Evaluation of the theoretical lectures

The result of this evaluation will be 7,0 points of the final course score.

There will be a midterm exam, suitable to pass the material, after the first four-month period about the contents for the issues of introduction and blocks 1, 2 and, and a second exam at the end of second four- month period (containing subject of blocks 4 and 5). In this exam it may also undertake a review of the contents of the first partial. The exams will be past due with a score greater than or equal to 5 (of 10). It will also evaluate the student's participation in the resolution of questions as well as the discussion of these questions in classes and tutorials. The qualifications of the approved exams, or the whole theory, will be saved only until the second call.

Evaluation of the problems

The result of this evaluation corresponds with 1,0 point in the final course score. The last session of each term problems will be devoted to carrying out a partial qualifying round test. In the first four-month period the exam shall be conducted on the contents of "buffer pH Solutions" and "Enzymology", and in the second four-month period on "Bioenergetics." The problems will be

considered approved if the course score earned in each of the two partial tests are equal or superior to 5 (of 10).

There will be a final test of problems, to be performed in conjunction with the examination of the theory, in which students will be examined for any party that has not been surpassed in the partial tests. The passing score on the problems will be saved until the second call.

Evaluation of the laboratory

This part will represent up to 1,0 point in the final course score. The laboratory sessions will be evaluated by two partial exams, the attitude and use in the laboratory and the correction of the practical questionnaires. In the first four-month period, the exam will be on practices 1 to 4. In the second, the practices 5 and 6. The laboratory practices are considered as passed when the marks of the two written tests are equal or superior to 5 (of 10).

There will be a final written exam for the laboratory sessions that will be done together with the theoretical exam, in which students will examine the parts not passed on partial exams. In case of approval the laboratory practices, but not the subject as a whole, the marks of practices will be saved for the year after.

Evaluation of the interdisciplinary seminar

The grade obtained in the interdisciplinary work will account for 10% of the grade for the subject. The tutor and an assistant lecturer (cotutor) will participate in the grading and will take into account both the oral presentation of the work and the written text. In these assessments, the relative weight of the tutor's and co-tutor's marks will be 60% and 40%, respectively. The evaluation of this activity will take into account both the scientific content and the way in which it has been presented, especially the ability to communicate and transmit ideas and concepts. The works selected for presentation at the Biology Congress will receive an extra mark, corresponding to 10% of the mark for the activity.

In the event of failing the course, the grade for the interdisciplinary work will be saved for the following year.

In the event that the interdisciplinary work (of a compulsory nature) is not carried out, this subject will be failed if it is the subject linked to this interdisciplinary work, regardless of the grade obtained in the rest of the subject.

Evaluation of the reading and summarize a general book and other activities

The activities will be evaluated with a maximum score of 0,5 points, which will be added to the score of the rest of the course.

Evaluation of the second call

It will follow the same evaluation criteria that have been exposed for the first call and it consist of a unique exam of theory (7,0 points), problems (1 point) and laboratory (1,0 point) of the subject. The interdisciplinary project is not done more than once during the course.

REFERENCES

Basic References

- Peretó, J., Sendra, R., Pamblanco, M. and Bañó, C. Fonaments de bioquimica. Servei de Publicacions de la Universitat de València, 5ª ed., 2005 (in spanish, 2007).
- Stryer, L., Berg, J.M. and Tymoczko, J.L. Bioquímica Curso básico Ed. Reverté, 2014 (3ª ed., in english, 2016).
- Stryer, L., Berg, J.M. and Tymoczko, J.L. Bioquímica con aplicaciones clínicas Ed. Reverté, 7ª ed., 2013 (from the english edition , 2012).
- Stryer, L., Berg, J.M. and Tymoczko, J.L. Bioquímica. Ed. Reverté, 6ª ed., 2007 (català) (9th ed., english, 2019).
- Nelson, D.L. and Cox, M.M. Lehninger. Principios de Bioquímica. Ed. Omega, 7ª ed., 2017 (7th ed., english, 2017).
- McKee, T. Bioquimica. Las bases moleculares de la vida. Ed .McGraw-Hill, 7ª ed., 2020.

Complementary References

- Alberts, B. and colaborators. Biología Molecular de la Célula. Ediciones Omega, 5ª ed., 2010 (6ª ed., english, 2014).
- Mathews, C.K., Van Holde, K.E., Ahern K.G. and Anthony-Cahill, S.J. Bioquímica. Ed. Pearson, 4ª ed., 2013.
- Voet, D., Voet, J.G. and Pratt C.W. Fundamentos de Bioquímica. La vida a nivel molecular. 4ª ed., Panamericana. 2016 (5ª ed. in english 2016).