COURSE DESCRIPTION

COURSE DETAILS

Title (of the course): **BIOQUÍMICA**
Code: 102210
Degree/Master: **GRADO DE CIENCIA Y TECNOLOGÍA DE LOS ALIMENTOS** Year: 1
Name of the module to which it belongs: FORMACIÓN BÁSICA COMÚN
Field: BIOQUÍMICA
Character: BASICA
Duration: SECOND TERM
ECTS Credits: 6.0
Classroom hours: 60
Face-to-face classroom percentage: 40.0%
Study hours: 90
Online platform: http://moodle.uco.es/m1920/

LECTURER INFORMATION

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PREREQUISITES AND RECOMMENDATIONS

Prerequisites established in the study plan

None.

Recommendations

We suggest to use the indicated Bibliography and all the additional information provided along the course.

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INTENDED LEARNING OUTCOMES

CB1	To make students able to show they know and understand contents in a given study area from the basis of general secondary education, considering that this information can be found at a level that, based on specialised text books, also includes some aspects that entail knowledge from the recent advance in their study field.
CB2	Students will know how to apply their knowledge to their job or professional vocation, and will possess the knowledge that they can demonstrate by means of developing and defending arguments, and solving problems within their area of study.
CB3	To make the students able to obtain and interpret relevant data (normally within their field of study) to reflect on social, scientific and ethical topics
CB4	To make students able to share information, ideas, problems and solutions with an audience of specialists and non-specialists
CB5	To make students able to develop necessary learning abilities to begin further study with a high degree of independence
CU2	Improving user-level skills in ICT
CT1	Ability to correctly express oneself in the Spanish language in its disciplinary field.
CT2	Ability to resolve problems.
CT4	Ability to put knowledge into practice
CT7	Analysis and synthesis skills.
CT10	To have developed the incentive for quality.
CT11	Organisational and planning skills.
CT12	Information management skills.
CE1	To recognise and apply the necessary physical, chemical, biochemical, biological, physiological, mathematical and statistical principles for understanding and developing Food Science Technology.

OBJECTIVES

Study and understanding of the basis of life, in order to know the functioning of living beings at the molecular level, and the applications to study foods.

CONTENT

1. Theory contents

I Proteins and enzymes

1. Amino acids and peptides. Functional diversity of amino acids. Structure, classification and properties. Essential, non essential and modified amino acids. The peptide bond. Peptides of biological interest.

2. Proteins. 3D conformation. Structural levels. Secondary structure: alpha helix and beta sheet. Beta gyres. Tertiary structure: motifs and domains. Quaternary structure. Forces and interactions which keep the protein structure. Relationship between structure and biological function: comparative study of myoglobin and haemoglobin. Collagen: supercoiled structure. Membrane and regulatory proteins.

3. Enzymes. Nature, properties and classification. Enzymatic cofactors: concept and classification. Mode of action of enzymes: bioenergetics of catalysis. Complex enzyme-substrate. Applications of enzymes. Regulation of metabolic pathways. Regulation of enzymes. Allosteric enzymes and enzymes regulated by covalent modification. Proteolytic activation of zymogens. Isoenzymes.

II Bioenergetics and introduction to metabolism

4. Bioenergetics, membranes and transport. Importance of redox processes in living beings. Concept and

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quantification of ΔG. Activated intermediate. ATP: functions. Difference of potential between two redox pairs. Relationship between ΔG, ΔE and Keq. Biomembranes: composition and function Characteristics and types of mediated transport.

5. Intercellular communication. Basic concepts of the intercellular communication. Signal molecules and signal receptors. Types of signals mediated by membrane receptors linked to G protein, enzymes and intracellular receptors.

6. Introduction to metabolism and Krebs cycle. Global view of metabolism: catabolism, anabolism and regulation. Central role of the Krebs cycle in metabolism. Reactions. Energetic balance and regulation. Amphibolic character of the cycle. Anaplerotic reactions.

7. Respiratory chain and oxidative phosphorylation. Electron transport chain: complexes, transporter proteins and sequence of reactions. ATP-synthase. Oxidative phosphorylation and respiratory control. Uncouplers and phosphorylation inhibitors. Interchange of reducing power between mitochondria and cytoplasm: shuttles.

III Carbohydrates, lipids and nitrogen biomolecules metabolism

8. Glycolysis, fate of pyruvate, gluconeogenesis and pentose phosphate pathway. Global view of glycolysis. Phases: preparative and productive. Glycolytic utilization of other sugars and glycerol. Regulation and energetic balance of glycolysis. Metabolic fate of pyruvate. Lactic and alcoholic fermentation. Oxidative decarboxylation of pyruvate: pyruvate dehydrogenase complex. Gluconeogenesis from pyruvate and other gluconeogenic substrates and regulation Coordinated regulation of glycolysis and gluconeogenesis. Nature and goals of the pentose phosphate pathway. Oxidative, isomerization and interconversion reactions. Polyvalence of pathways.

9. Glycogen metabolism. Reserve polysaccharides. Catabolism and biosynthesis of glycogen. Glycogen phosphorylase and glycogen synthase. Regulation. Differences in the regulation of carbohydrate metabolism in muscle and liver. Carbohydrate metabolic fluxes in liver.

10. Catabolism and biosynthesis of fatty acids. Introduction to lipids metabolism. Fat reserves in the organism: lipolysis and regulation. Degradation of fatty acids: activation and transport into mitochondria. Beta-oxidation of saturated, insaturated and odd chain fatty acids. Ketone bodies metabolism. Biosynthesis of fatty acids: synthesis of malonil-CoA. Synthase of fatty acids. Elongation and insaturation. Essential fatty acids. Regulation of fatty acids metabolism. Biosynthesis of triacilglycerols and glycerophospholipids.Metabolism of steroids and lipoproteins. Synthesis of cholesterol and regulation. Structure and function of lipoproteins. Derivatives of cholesterol: bile acids and steroid hormones.

12. Metabolism of amino acids. Introduction to nitrogen metabolism. Catabolism of amino acids: Transamination and oxidative deamination. Fate of N and carbon skeletons. Urea cycle: reactions and relationship with the Krebs cycle. Biosynthesis of amino acids: incorporation of ammonium into carbon skeletons. Biosinthetic families.

13. Nucleotide metabolism: Nitrogen bases, nucleosides and nucleotides. Biosynthesis of purine and pyrimidine nucleotides. Interconversion of mono, di and tri-P nucleotides. Biosynthesis of deoxyribonucleotides. Regulation. Bases recovery pathway. Nucleotide and purine and pyrimidine bases degradation. Removal of nitrogen from nitrogen bases.

14. Integration of metabolism. Basic principles of metabolism. Regulation of metabolic pathways. Main metabolic pathways and control points. Specialized metabolic functions of different organs. Metabolic fluxes as a function of the nutrition state.

IV Molecular biology

15. Structure of genetic material. Identification of DNA as genetic material. Polynucleotide chain. Double helix of Watson and Crick (DNA-B). Alternative structures to DNA-B. Physico-chemical properties of DNA: denaturation. Virus and bacteria chromosomes. Eukaryotic chromosome. Types of RNA.

16. Chromosomic replication and reparation of DNA. Features of replication. Enzymes and proteins involved. Global process of replication: initiation, elongation and termination in prokaryotes. Replication in eukaryotes.

17. Transcription: RNA polymerases reaction. RNA polymerases in prokaryotes: subunits and functions. Transcriptional unit in prokaryotes. Phases of transcription: initiation, elongation and termination. Differences between transcription in prokaryotes and eukaryotes. Modification and processing of RNA: mRNA, rRNA and tRNA.Genetic code and translation.

18. Genetic code: general features. Components of ribosomes. Aminoacyl-tRNA synthetases. Phases of translation: initiation, elongation and termination. Differences in the translation in prokaryotes and eukaryotes. Antibiotics

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inhibitors of protein synthesis. Post-translational modifications and protein degradation.
19. Regulation of gene expression. Levels of control of gene expression. DNA recognition code. Structural motifs in regulatory proteins. DNA regions regulating transcription. Transcription regulation mechanisms in prokaryhotes. Regulation of transcription in eukaryotes. Activation by changes in chromatine. Enhancers and combinatory mechanisms. Gene silencing.
20. Short overview of the research carried out by the teachers.

2. Practical contents

CLASSROOM PRACTICES
CP I. AMINO ACIDS AND PEPTIDES. Problems and questions on the acid-base properties of amino acids. Determination of pI and electrophoretic mobility of amino acids and peptides.
CP II. ENZYMATIC KINETICS. Problems and questions on the bioenergetics of enzymatic catalysis. Lineweaver-Burk equation: Km and Vmax calculation. Effect of inhibitors on the kinetic parameters.
CP III. BIOENERGETICS AND ENERGETIC METABOLISM. Problems and questions on basic thermodynamic concepts, difference of potential between two redox pairs, relationship between ΔG, ΔE, Keq, activated intermediaries and coupled reactions, Krebs cycle, respiratory chain and oxidative phosphorylation.
CP IV. TRANSPORT. Problems and questions on transport bioenergetics: Na+/K+, ATPase, Ca2+-ATPase and secondary active transport systems.
CP V. BIOMOLECULES METABOLISM. Problems and questions on carbohydrate, lipids and nitrogen biomolecules.
LABORATORY PRACTICES
LP1. Quantitative analysis of proteins by the Lowry method.
LP2. Quantitative analysis of glucose by the glucose oxidase method.
LP3. Kinetics characterization of alkaline phosphatase.
LP4. Acid and enzymatic hydrolysis of polisaccharides.

METHODOLOGY

General clarifications on the methodology (optional)

Master classes, numerical problems and practical cases related to metabolism: a final examination will be done at the date determined by the Faculty of Veterinary, about the knowledge acquired through the magisterial lessons and classroom practices. Its mark will represent 68% of the final mark of the subject.
Classroom practices: We will work on the resolution of numerical problems and practical cases related to metabolism. Attendance and participation will be evaluated. The mark in this section will represent a 6 % of the final mark of the subject.
Laboratory practices: we will work in the basic utilization of laboratory instruments, and also the preparation of solutions. Evaluation will take into account the performance, attitude and results, and also the answer to a series of questions at the end of each session. The mark will represent 20% of the final mark of the subject.
Comprehensive reading: students will do 2 readings on matters selected by teachers, who will provide the necessary material and specify the procedure to follow. The comprehension of these readings will be evaluated in writing. The mark of this section will represent a 6 % of the final mark of the subject.

Methodological adaptations for part-time students and students with disabilities and special educational needs

Specific adaptations for part-time students will be taken into account.
Students with disabilities and special educative needs will be treated according to the indications received from the Faculty of Veterinary, providing more time for exams whenever necessary.

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Face-to-face activities

Activity	Large group	Medium group	Total
Assessment activities	2	2	4
Case study	-	15	15
Lab practice	-	10	10
Lectures	31	-	31
Total hours:	***33***	***27***	***60***

Off-site activities

Activity	Total
Activities	21
Reference search	9
Self-study	60
Total hours	***90***

WORK MATERIALS FOR STUDENTS

Case studies - *http://moodle.uco.es/m1920/*
Exercises and activities - *http://moodle.uco.es/m1920/*
Oral presentations - *http://moodle.uco.es/m1920/*
References - *http://moodle.uco.es/m1920/*

EVALUATION

Intended learnig	Document Analysis	Exams	Problem solving
CB1		X	
CB2	X		X
CB3	X	X	
CB4		X	
CB5		X	
CE1	X	X	
CT1		X	
CT10	X	X	

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Intended learnig	Document Analysis	Exams	Problem solving
CT11		X	X
CT12		X	
CT2	X	X	
CT4		X	X
CT7			X
CU2		X	
Total (100%)	***12%***	***68%***	***20%***
Minimum grade	***4.5***	***4.5***	***5***

(*)Minimum grade necessary to pass the course

Method of assessment of attendance:

Active attendance and participation in classroom and laboratory practices will be taken into account for evaluation.

General clarifications on instruments for evaluation:

A final examination will be done at the date determined by the Faculty of Veterinary on the concepts taught at the master classes and during the classroom practices. It will represent 68 % of the final mark of the subject.
Laboratory practices: Each practice will be evaluated based on the interest and participation of the student during its realization, the obtained results and the answers to questions which will be posed after the practice has been carried out. The mark will represent 20 % of the total of the subject.
Comprehensive reading and classroom practices: The comprehension of every reading will be evaluated in written. The mark in this section will represent 6 % of the final mark of the subject. In the classroom practices, attendance and participation will be evaluated. The mark of this section will be 6 % of the final mark of the subject.
The subject is passed with a mark of 5. It is required to have at least 45% of the points from the master classes and numeric problems, and a 50% of the points from laboratory practices. All parts of the program should be balanced. The final mark will include the total of points obtained in the different activities, upon condition of fulfilling the previously indicated requirements.

Clarifications on the methodology for part-time students and students with disabilities and special educational needs:

Specific considerations for part time students and students with especial needs will be taken into account. The overall evaluation system will be the same as for the rest of students.

Qualifying criteria for obtaining honors:

It will be reserved for students obtaining a mark equal or higher than 9.0 without being more than 5 % of the enrolled students. Honors will be given according to the obtained mark and to the continual evaluation from teachers along the course.

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BIBLIOGRAPHY

1. Basic Bibliography

BERG JM, TYMOCZKO, JL, GATTO GJ & STRYER L (2015) Biochemistry. (8th Ed), Freeman MacMillan.
NELSON DL & COX MM (2017) Lehninger Principles of Biochemistry. (7th Ed), MacMillan.
VOET D, VOET JG & PRATT (2016) Fundamentals of Biochemistry: Life at the Molecular Level (5th Ed), Wiley.

2. Further reading

GARRETT RH, GRISHAM CM (2017). Biochemistry (6th Ed.), Brooks/Cole, Cengage Learning.

COORDINATION CRITERIA

Tasks performance

Clarifications

The methodological strategies and the evaluation system contemplated in this Course Description will be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required.

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