# BIOCHEMISTRY COURSE SYLLABUS

Academic Year 2017-2018

## 1. COURSE DESCRIPTION

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|---|---|
| **Degree:** | **Biotechnology** |
| **Double Degree:** | **No** |
| **Course:** | **Biochemistry: metabolism and its regulation** |
| **Module:** | **Molecular Biology** |
| **Department:** | **Molecular Biology and Biochemical Engineering** |
| **Academic Year:** | **2016-2017** |
| **Term:** | **Fall** |
| **Total Credits:** | **6** |
| **Year:** | **2017-2018** |
| **Type of Course:** | **Fundamental** |
| **Course Language:** | **English** |

| **Teaching model:** | **B1** |
|---|---|
| **a. General/background:** | **60%** |
| **b. Theory-into-practice/developmental knowledge-building** | **40%** |
| **c. Guided Academic Activities:** | |

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## 2. COURSE COORDINATOR

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|---|---|
| **Name:** | **Francisco J.Bedoya Bergua** |
| **School:** | **Experimental Sciences** |
| **Departament:** | **Molecular Biology & Biochemical Engineering** |
| **Academic Field::** | **Biochemistry & Molecular Biology** |
| **Position** | **Professor** |
| **Office hours:** | **Tuesday,Wednesday & Thursday, 12- 14 pm**<br>**Request of appointment by e-mail through the portal of the course at the Virtual Classroom** |
| **Office No.:** | **Building 22, room 3-08** |
| **E-mail:** | **fbedber@upo.es** |
| **Tel.:** | **954977934** |

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## 3. ACADEMIC CONTEXT

### 3.1. Course Description and Objectives

The course seeks to explore the molecular bases of life. Emphasis will be placed on chemical transformations underlying metabolic features in animal cells and tissues.

The aims of the course can be summarized as follows:

1. Description and integration of the metabolic pathways that play a role in the handling of energy processes in cells.

2. Description of the molecular bases of the major cellular processes.

3. Knowledge of the main signaling pathways that control cell metabolism

4. Application of knowledge to solve exercises related with metabolic pathways and its alterations.

### 3.2. Contribution to the Training Plan

The course addresses the knowledge of chemical changes occurring in cells from the perspective of its basic support of vital functions of growth, replication, maintenance of structure and integrity of the cell and its response to the environment. Achieving the objectives of the course will provide the student with tools to understand the close coordination in the functioning of metabolic pathways and for the study subjects such as Genetic Engineering, Microbial Physiology and Metabolism and Molecular Genetics in the module of Biochemistry and Molecular Biology .

### 3.3. Recommendations or Prerequisites

It is recommended that students have background knowledge in cell biology, organic chemistry, structure of biomolecules, bioenergetics and enzimology. In addition, the students should be fluent in written and spoken English and have experience in text processing programs, scientific citation and in the handling of the Virtual Classroom Application.

## 4. COMPETENCES

### 4.1 Degree Skills Developed during this Course

**Basic competences of the Training Plan in Biotechnology**

CB1: Students should demonstrate to have and understand knowledge in a study area coming from secondary education and usually found in level provided in advanced textbooks; it also includes aspects that involve knowledge coming from the vanguard in the field.

CB2: Students should know how to apply their knowledge to their work and vocation in a professional manner. They should also possess competences that often can be demonstrated by elaborating and defending arguments and also by solving problems in their field of study.

CB 4: Students should be able to convey information, ideas, problems and solutions to both expert and lay audiences.

CB5: Students should have developed learning skills needed to start on later studies with high degree of autonomy.

CG1 Know and comprehend general biological processes in living organisms from a molecular, cellular, physiological and, when appropiate, comunity wise.

CG2 Know and comprehend basic facts, concepts, principles and theories related with livng organisms and their mutual influence on human activity.

CG3 Students should be able to use correctly terminology, nomenclature and systematic of classification in every subject imparted in the degree.

CG 4 Understand the scientific method. Know, understand and apply tools, techniques and experimental protocols in the laboratory and adquire observational and intrepretational skils to be applied on the results obtained.

CG5 Adquire the skills needed in every subject imparted by means of description, quantitation, analysis and critical assessment of the experimental results obtained autonomously.

CG6 Work properly in biology, chemistry and biochemistry laboratories, by knowing and applying the regulations and techniques related with safety, hygiene, animal manipulation

and waste disposal.

CG8 Adquire, develop and apply the most relevant techniques for preparation, staining and observation of biological samples.

### 4.2. Module Skills Developed during this Course

CE12 Understand the cell theory and identify the cell components and describe the molecular mechanims involved in the main cellular events.

CE24 Comprehend adequately the concept of measurement in science, including the correct use of units and the meaning and management of experimental error.

### 4.3. Course-specific Skills

1.Develop the concept of metabolic fluxes and metabolic networks
2.Describe, integrate and solve problems about metabolic pathways and its control
3 Describe in detail the metabolism of biomolecules in animal cells

## 5. COURSE CONTENT (COURSE TOPICS)

**General Topics**

1. General features of metabolism
   1.1. Structure and types of metabolic pathways
   1.2. Principles and types of metabolic regulation
2. Citric acid cycle, the respiratory chain and phosphorylative oxidation
   2.1. Role un cell metabolism
   2.2. Cycle description. Anaplerotic rections
   2.3. Structure of the respiratory chain and energetics of electronic transport
   2.4. Oxidative phosphorylation. Structure of ATP synthase.
   2.5. Control of electronic transport and oxidative phosphorylation
3. Carbohydrate metabolism
   3.1. Glycolysis. Metabolic basis of Pasteur and Warburg effects
   3.2. Transformations of pyruvate: fermentations and oxidative decarboxilation
   3.3. Pentose phosphate pathway
   3.4. Neoglucogenesis
   3.5. Synthesis and degradation of glycogen
4. Lipid metabolism
   4.1. Plasmatic lipoproteins
   4.2. Fatty acid degradation
   4.3. Fatty acid synthesis
   4.4. Isoprenoid metabolism
   4.5. Metabolism of membrane lipids and icosanoids
5. Amino acid metabolism
   5.1. Degradation of the amino group
   5.2. Degradation of de carbon backbone
   5.3. Biosynthesis of amino acids
6. Metabolism of nucleotides
   6.1. Degradation of purine and pyrimidine nucleotides
   6.2. Recycling an biosynthesis of purines and pyrimidines

**Theory-into-practice/developmental knowledge-building**

There are two types of activities:

1. Laboratory sessions
   Throughout sessions the student will learn to work in the laboratory of biochemistry. For that, the student will learn how to use the measuring equipment, will carry out experiments that show the metabolic transformations of selected biomolecules and above all, will develop the fundamentals of metabolic analysis
2. Problem sessions
   The student will apply the acquired knowledge to solve problems in cell metabolism

**Laboratory Session 1**

**Cell Fractionation**

- **Separation Methods: Separation of nuclei, mitochondria and cytosol**
- **Markers for cell constituents**

**Laboratory Session 2**

**Quantification of Oxidative Damage**

- **Production of oxidative damage**
- **Determination of final end products**
- **Quantification of damage**
- **Quantification of protection**

**Laboratory Session 3**

**Lipid Metabolism**

- **Separation and determination of lipoproteins**
- **Determination of Triglycerides**
- **Identification of ketone bodies**

**Laboratory Session 4**

**Metabolism of Nitrogenated Biomolecules**

- **Analysis of urea**
- **Analysis of uric acid**
- **Analysis of transaminases**
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**Laboratory Session 5**

**Kinetic Assay of Glucose Phosphorylating Enzymes**

- **Hexokinase**
- **Glucokinase**

**2. Problem Sessions**

**Problem Session 1**

**Metabolism and biological oxidations**

- **Bioenergetics**
- **Citric acid cycle**
- **Oxidative phosphorylation**

**Problem Session 2**

**Carbohydrate metabolism**

- **Glycolysis**
- **Glycogen metabolism**
- **Pentose phosphate pathway**

**Problem Session 3**

**Lipid Metabolism**

- **Lipolysis**
- **Synthesis of ketone bodies**
- **Biosynthesis of cholesterol and fatty acids**

## 6. METHODOLOGY AND RESOURCES

**Methodology**

Lectures of 60 min. supported with slide presentations.
Problem solving sessions with individual and team work.
Laboratory sessions with individual work
Personal work
Writing exams

**Resources**

Teaching laboratory
Webpage at Virtual Classroom (Blackboard, former WebCT): supplementary teaching material, chats, links to web pages, discussion forum, plagiarism prevention tool.

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## 7. ASSESSMENT

The assessment of the subject will based on the following items:

- **General Topics**
  It will be worth 60%
  - Participation at the class ( up to 1 point)
  - Final exam (up to 5 points)
    - Can be taken at the end of the term and in July
    - The contents to be explored will be made public in advance

- **Theory-into-practice/developmental knowledge-building**
  It will be worth 40%
  - Problem Session
    4 sessions are scheduled. The problems will be uploaded on the web page and they will be dealt with in the classroom Students will work in teams and they will present the results in the class. For the presentation, students will be selected randomly among the members of the team If the students are unable to explain the answers or fail to attend the classes, they will be scored negatively. Every session will be worth 0.5 points.
  - Laboratory Session
    4 sessions are scheduled. Assessment will be carried out by the presentation of a Laboratory log book and by taking a practice exam.

    The Laboratory log book will be worth up to 1 point and the practice exam will be worth up to 1 point.

## 8. BIBLIOGRAPHY

### Introductory Reading

- **Biochemistry Illustrated : biochemistry and molecular biology in the post-genomic era**
  **PN. Campbell, AD. Smith , T.Peters**
  Elsevier Churchill Livingstone 5th ed. 2005.
  This book aims to provide a survey of biochemistry in a easy assimilable form. It is addressed to students who appreciate a sketchy summary of the subjects before starting a more advanced study required in this course
  Available at the library

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# Core Books

- **Lehninger Principles of Biochemistry DL Nelson, MM Cox**
  WH Freeman & Co. 2013, 6th edition
  This book has been the reference book for biochemistry students for more than 40 years. Metabolism is reasonably well addressed and it will be the core manual of the course.
  The sixth English edition is available at the library

- **Biochemistry**
  **JM Berg**
  Freeman & Co. 2002, 5th edition
  An alternative to Lehnigers's biochemistry that is also available at the library