

## Course guide

### 295603 - BQB - Biochemistry

Last modified: 03/07/2022

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.

**Degree:** BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Optional subject).

**Academic year:** 2022    **ECTS Credits:** 6.0    **Languages:** English

#### LECTURER

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**Coordinating lecturer:** LUIS J. DEL VALLE MENDOZA

**Others:** NEKANE HERNÁNDEZ LOZANO  
DAVID ZANUY GOMARA  
NÚRIA SAPERAS PLANA

#### TEACHING METHODOLOGY

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Expository methodology of the theory in 30%. Individual and group laboratory work in 10%. Individual and/or group non-contact work in 60% (autonomous learning).

The student has support material (such as outlines and supporting documents for theory classes, thematic PDFs, the practices guide, references for additional readings, etc.) at ATENEA. Autonomous learning is also promoted, in particular through deliverables and the interaction sought in the theoretical classes.

#### LEARNING OBJECTIVES OF THE SUBJECT

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Provide the student with knowledge about the chemical structure of the main groups of biological macromolecules. Likewise, introduce the student to the different techniques and methods for the structural characterization of biomacromolecules.

#### STUDY LOAD

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Type	Hours	Percentage
Hours small group	30,0	20.00
Hours large group	30,0	20.00
Self study	90,0	60.00

**Total learning time:** 150 h

## CONTENTS

### 1. Amino acids, peptides and proteins

**Description:**

Amino acids: structure of amino acids, dipolar structure of amino acids, isoelectric point, synthesis of  $\alpha$ -amino acids. Peptides: Covalent Bonding in Peptides, Peptide Structure Determination (Amino Acid Analysis), Peptide Sequencing (Edman Degradation, C-Terminal Residue Determination), Peptide Synthesis, Automated Peptide Synthesis (Solid Phase Synthesis). Proteins: classification, structure, enzymes, denaturation.

**Full-or-part-time:** 11h

Theory classes: 5h

Self study : 6h

### 2. Carbohydrates

**Description:**

Carbohydrates: classification, Fischer projections, D, L sugars, aldose configuration. Monosaccharides: cyclic structures, mutarotation, conformations, reactions, glucose stereochemistry. Disaccharides. polysaccharides. Carbohydrates on cell surfaces.

**Full-or-part-time:** 11h

Theory classes: 5h

Self study : 6h

### 3. Lipids

**Description:**

Waxes, fats and oils. soaps. phospholipids. Biosynthesis of fatty acids. Prostaglandins. Terpenes and biosynthesis of terpenes. Steroids and Steroid Stereochemistry

**Full-or-part-time:** 11h

Theory classes: 5h

Self study : 6h

### 4. Heterocycles and Nucleic Acids

**Description:**

Unsaturated heterocycles. Structure of pyrrole, furan and thiophene, and their electrophilic substitution reactions. Pyridine: structure, electrophilic and nucleophilic substitution. Closed heterocycles: Pyrimidine and purine. Nucleotides and nucleic acids: DNA structure, base complementarity (Watson-Crick model), nucleic acids and genetic information, DNA replication. Structure and synthesis of RNA (transcription). RNA and protein biosynthesis (translation). DNA sequencing. DNA synthesis.

**Full-or-part-time:** 11h

Theory classes: 5h

Self study : 6h



#### 5. Structural determination: Ultraviolet-visible spectroscopy (UV-Vis) and circular dichroism (DC)

**Description:**

UV-Vis spectroscopy: fundamentals, interpretation of spectra, identification of chromophores and conjugated systems, quantitative applications, application to the study of DNA and protein denaturation. Circular dichroism spectroscopy: fundamentals, interpretation of spectra and applications for the study of the secondary structure of proteins and nucleic acids.

**Full-or-part-time:** 9h

Theory classes: 5h

Self study : 4h

#### 6. Structural determination: Mass spectroscopy (MS) and infrared spectroscopy (FTIR)

**Description:**

Mass spectroscopy: fundamentals, interpretation of spectra, interpretation of fragmentation patterns, application for the determination of molecular weight. Infrared spectroscopy: fundamentals, FTIR, interpretation of spectra of organic molecules (functional groups), application to determine protein secondary structure.

**Full-or-part-time:** 10h

Theory classes: 4h

Self study : 6h

#### 7. Structural Determination: Nuclear Magnetic Resonance Spectroscopy (NMR)

**Description:**

NMR spectroscopy: fundamentals, <sup>13</sup>C and <sup>1</sup>H NMR, absorption, chemical shift, integration of peaks in the spectra, interpretation of the spectra, and application for the identification of molecules.

**Full-or-part-time:** 10h

Theory classes: 4h

Self study : 6h

#### 8. Structural determination: X-ray diffraction (XRD)

**Description:**

X-ray diffraction: fundamentals, powder diffraction, fiber diffraction, single crystal diffraction, interpretation of spectra, and applications for the structural determination of macromolecules.

**Full-or-part-time:** 10h

Theory classes: 4h

Self study : 6h

#### 9. Purification of macromolecules

**Description:**

Preparative methods: cell extracts, cell lysis, precipitation, solvent extraction, dialysis, filtration and ultrafiltration, evaporation, lyophilization. Centrifugation: sedimentation, differential and gradient centrifugation, ultracentrifugation. Analytical ultracentrifugation and structural determination of proteins and nucleic acids. Low and high pressure liquid chromatography. Electrophoresis.

**Full-or-part-time:** 11h

Theory classes: 5h

Self study : 6h



## GRADING SYSTEM

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The final grade (Nfinal) will be the sum of the grades weighted with the hours of dedication of each of the units or contents. N1: contents 1-4. N2: contents 5-9. AA: Autonomous learning. L: laboratories. CG: qualification of generic competence

$$N_{\text{final}} = 0.30 N1 + 0.35 N2 + 0.15 AA + 0.15 L + 0.05 CG$$

In the event that the Final is less than 5, there will be a final test that will include all the units of both theory and practical activities.

## BIBLIOGRAPHY

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### Basic:

- Devlin, Thomas M. Bioquímica : libro de texto con aplicaciones clínicas [on line]. Cuarta edición. Barcelona: Editorial Reverté, S.A, 2004 [ Consultation: 13/09/2022]. Available on: [https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB\\_BooksVis?cod\\_primaria=1000187&codigo\\_libro=7726](https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=7726). ISBN 9788429194340.
- Voet, Donald; Voet, Judith G. Bioquímica. 3a ed. Buenos Aires [etc.]: Médica panamericana, cop. 2006. ISBN 9789500623018.
- Mathews, Christopher K; Van Holde, K. E; González de Buitrago, J. M. Bioquímica. 4a ed. Madrid [etc.]: Pearson Addison Wesley, cop. 2013. ISBN 9788490353110.
- Koolman, Jan; Röhm, Klaus-Heinrich ; Wirth, Jürgen. Bioquímica : texto y atlas. 3a ed. rev. y ampl. Madrid ; Buenos Aires: Médica Panamericana, cop. 2004. ISBN 8479037245.
- Stryer, Lubert; Berg, Jeremy M; Tymoczko, John L; Gatto, Gregory J. Bioquímica : con aplicaciones clínicas. 7a ed. Barcelona: Reverté, cop. 2015. ISBN 9788429176070.
- Lehninger, Albert L; Bozal Fes, Jorge; Cortés Tejedor, Antonio. Principios de bioquímica. Barcelona: Omega, cop. 1984. ISBN 8428207380.