



**Degree Programme in Medicine and Surgery**  
*Academic Year 2026 /2027*

**COURSE:** Chemistry and Introductory Biochemistry

**NUMBER OF CFU (ECTS credits):** 6

**SSD (Academic Discipline Code):** BIOS-07/A

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**PREREQUISITE COURSES**

None required.

**PREREQUISITES**

Knowledge of fundamental mathematics concepts (logarithms, exponentials, quadratic equations). General knowledge of atomic structure, stoichiometry, the general rules of nomenclature for inorganic chemical compounds, and the rules for their correct writing.

**LEARNING OBJECTIVES**

The main aim of this course is to allow the students to - learn the major chemical and physical principles which govern organism life. The course will further cover the study of the composition of inorganic and organic compounds as well as the reactions they undergo.

These aims will be pursued through interactive frontal lectures, exercise sessions designed to optimize learning and to maximize the student skill in recognizing and solving a given medicinal chemistry task.

### **EXPECTED LEARNING OUTCOMES**

By the end of the course, the student will be expected to acquire the following skills:

#### **DD1: Knowledge and understanding**

The course of Chemistry and Introductory Biochemistry is aimed at allowing the students to learn the chemical, physical and molecular bases of main principles and laws of molecular chemistry and biochemistry. At the end of the Chemistry and Introductory Biochemistry course, the student is expected to be able to identify the composition of inorganic compounds present in nature and how they interact and react with each other during patho-physiological processes in human body. The student is asked to learn the water-based reactions, acid-base theories, and their role in maintaining homeostasis. The course is further organized to provide the students with the basis of the chemistry of Carbon, i.e. organic chemistry, with a special focus on how organic compounds are structurally arranged and how they react to form the building blocks of life.

#### **DD2: Applying knowledge and understanding**

The student will learn how to apply the knowledge acquired during the course to the clinical tasks his/her profession is expected to deal with. This will allow the student to recognize critical diagnostic items and prognostic outcomes by deciphering how a given chemical and metabolic alteration turns out into a pathological condition. At the end of the course, the student will be able to apply this knowledge to the specific clinical area where he/she will dedicate his/her medical activity.

#### **DD3: Making judgements**

Specific attention will be paid to let the students improve the critical capacity when studying key chemical processes which underscore metabolic reaction of living organisms with clinical relevance. The students are expected to learn how critical is to bear a solid conceptual knowledge of each specific clinical task.

#### **DD4: Communication skills**

The student must be able to present all the topics covered in an organized and coherent manner. He/She must also use scientific terminology appropriately and consistently with the topic under discussion.

#### **DD5: Learning skills**

At the end of the integrated teaching, the student will acquire useful skills to deepen and expand their knowledge in the field of the course, also through the consultation of scientific literature, databases, and specialized websites.

### **SYLLABUS**

#### **-General/Inorganic Chemistry**

- INTRODUCTORY REMARKS- Periodic table of elements and inorganic nomenclature.
- ATOMIC CONSTITUTION - Elementary particles: proton, neutron, electron. Isotopes. Electrons and electronic configuration of atoms. Quantum numbers and orbitals. Aufbau principle. Chemical bonding.
- STATES OF AGGREGATION OF MATTER - Gases: ideal gas law equation. Absolute temperature and relation to average molecular velocity. Gaseous mixtures; Dalton's law.
- Liquids: vapor pressure of a liquid. Solids: structural characteristics of covalent, ionic, molecular, and metallic solids.

- CHEMICAL THERMODYNAMICS - Thermodynamic potentials; enthalpy; entropy; free energy: correlation with enthalpy and entropy.
- SOLUTIONS - Solution concentration. Dilutions and mixing of solutions. Vapor pressure of a solution (Raoult's law). Colligative properties. Gas solubility in liquids: Henry's law. Heterogeneous systems: definition of saturated solution. Solubility product constant and common-ion effect.
- CHEMICAL EQUILIBRIUM - Expression of the equilibrium constant. Factors influencing equilibrium. Homogeneous and heterogeneous equilibria.
- ELECTROLYTE SOLUTIONS - Strong and weak electrolytes; degree of dissociation. Colligative properties of electrolyte solutions; Van't Hoff factor. Acids and bases according to Arrhenius, Brønsted-Lowry, and Lewis. Strong and weak acids and bases. pH; pH calculation in strong and weak acid (and base) solutions. Salt hydrolysis. Buffer solutions.
- CHEMICAL KINETICS - Introduction to kinetics; activated complex theory; activation energy. Rate equations and reaction order. Relationship between rate constants and the equilibrium constant.
- OXIDATION-REDUCTION REACTIONS - Oxidation number. Oxidation-reduction reactions and their balancing.

#### **-Organic Chemistry**

- CARBON ATOM HYBRIDIZATION -  $sp^3$ ,  $sp^2$ , and  $sp$  hybridization and their geometry.
- HYDROCARBONS - Saturated hydrocarbons: alkanes and cycloalkanes. Nomenclature. Conformational isomerism and geometric isomerism (cis-trans). Unsaturated hydrocarbons: alkenes and alkynes. Nomenclature and main reactions.
- AROMATIC COMPOUNDS - Benzene structure: resonance model. Nomenclature of aromatic compounds and main reactions. Polycyclic aromatic hydrocarbons (overview).
- ALCOHOLS, PHENOLS, THIOLS - Nomenclature. Reactivity, acidity, and basicity of alcohols and phenols. Thiols, analogs of alcohols and phenols.
- ALDEHYDES AND KETONES - Nomenclature. Preparation of aldehydes and ketones. The carbonyl group. Nucleophilic addition to carbonyl groups; formation of hemiacetals and acetals. Aldol condensation (overview).
- CARBOXYLIC ACIDS AND THEIR DERIVATIVES - Nomenclature of carboxylic acids and derivatives. Carboxylic acid derivatives: esters, amides. Esterification mechanism; glycerol triesters. Main reactions.
- AMINES AND OTHER NITROGENOUS COMPOUNDS - Classification of amines and nomenclature. Basicity of amines. Comparison between the basicity of amines and amides.
- STEREOISOMERISM - Chirality. Enantiomers. Polarized light; the polarimeter (overview); diastereomers.

#### **-Introductory Biochemistry**

- CARBOHYDRATES - Definitions and classification. Monosaccharides. Chirality in monosaccharides; Fischer projections. Cyclic structures of monosaccharides. Anomers. Mutarotation phenomenon. Pyranose and furanose structures.
- LIPIDS - Definitions and classification. Properties, structure, functions, and nomenclature.

- AMINO ACIDS, PROTEINS - Properties of amino acids. Peptide bond. Primary, secondary, tertiary, and quaternary structure.
- NITROGENOUS BASES AND NUCLEOTIDES - Structure, nomenclature, properties.

### **COURSE STRUCTURE**

The course consists of 60 hours of classroom teaching and includes theoretical lectures and exercises in general, organic, and introductory biochemistry on the topics covered. Attendance is mandatory for at least 67% of the total course hours, which is a necessary requirement for admission to the examination.

### **COURSE GRADE DETERMINATION**

Student preparation will be assessed through a written exam. The written test consists of multiple-choice questions lasting 1 hour. The questions may require performing calculations and writing/identifying structural formulas. 1 point will be awarded for each correct answer, while there are no penalties for incorrect or missing answers, for which zero points will be awarded.

This written test will evaluate the student's ability to apply knowledge and ensure that their competencies are adequate to address and solve chemical-medical problems. Furthermore, through theoretical/conceptual questions, the following will also be assessed: independent judgment, communication skills, and learning capacity, in accordance with the Dublin descriptors. The exam will be passed with a minimum score of 18/30 and will be evaluated overall according to the following criteria:

|               |                                                                                                                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Fail</b>   | Significant gaps and/or inaccuracies in knowledge and understanding of the topics; limited analytical and synthesis skills; argumentation absent or frequently incorrect.                            |
| <b>18–20</b>  | Barely sufficient knowledge and understanding of the topics, with possible imperfections; sufficient analytical, synthesis, and judgement skills.                                                    |
| <b>21–23</b>  | Routine knowledge of the topics; correct analytical and synthesis skills with coherent logical argumentation.                                                                                        |
| <b>24–26</b>  | Fair knowledge and understanding of the topics; good analytical and synthesis skills; rigorously expressed argumentation.                                                                            |
| <b>27–29</b>  | Complete knowledge of the topics; considerable analytical and synthesis skills; good independent judgement.                                                                                          |
| <b>30–30L</b> | Excellent level of knowledge and understanding. Considerable analytical, synthesis, and independent judgement skills. Original argumentation expressed with full command of specialized terminology. |

Please note that during the written test, it is not permitted to use or keep at your desk any course packs, manuals, notes, electronic devices (tablets, earphones, mobile phones, smartwatches, smart glasses, or smart pens), or other reference materials. The detection of possession or use of unauthorized devices or

materials, as well as any violation of the exam rules, will result in the immediate cancellation of the test and the consequent loss of its validity.

For students with Specific Learning Disorders or Special Educational Needs certified by the competent University offices, compensatory measures and test arrangements indicated in the official documentation will be granted, subject to prior approval by the instructor and in accordance with University regulations. Any accommodations are agreed upon with the instructors while respecting the equivalence of the learning outcomes being assessed.

### **OPTIONAL ACTIVITIES**

Instructors are available by appointment for student office hours. These meetings can be held either in person or online. Additionally, throughout the course, targeted practice sessions and simulations will be organized to help students progressively consolidate their understanding of the topics covered.

### **READING MATERIALS**

Lectures will be supported by teaching materials (slides) uploaded and made available for consultation on the WebApp platform. For individual study and in-depth review, one of the following reference textbooks is recommended:

- McMurry, J. E., Ballantine, D. S., Hoeger, C. A., & Peterson, V. E. (2020). *Fundamentals of General, Organic, and Biological Chemistry* (8th ed.). Pearson.
- Atkins, P., Jones, L., Laverman, L., Young, K., & Patterson, J. (2023). *Chemical Principles: The Quest for Insight* (8th ed.). W. H. Freeman & Company.