BASIC SCIENCES (MZ000001)

1. language

English

2. course contents

Coordinator: Prof. DE SPIRITO MARCO
Year Course: I
Semester: 1st semester
CFU/UFC: 14
Modules and lecturers:
- CHEMISTRY/BIOCHEMISTRY INTRO (MZ000046) - 1 CFU - SSD BIO/10 Prof. Andrea Silvestrini
- CHEMISTRY/BIOCHEMISTRY (MZ000047) – 8 CFU - SSD BIO/10: Prof. Manuela Bozzi, Prof. Enrico Di Stasio, Prof. Antonia Iazzetti, Prof. Giuseppina Nocca
- PHYSICS – INTRODUCTION (MZ000048) – 1 CFU - SSD FIS/07 Prof. Marco De Spirito
- PHYSICS – MECHANICS (MZ000049) – 1,50 CFU - SSD FIS/07 Prof. Flavio Di Giacinto
- PHYSICS – THERMAL AND WAVES (MZ000050) – 1,50 CFU - SSD FIS/07 Prof. Marco De Spirito
- PHYSICS - ELECTROMAGNETISM (MZ000051) – 1 CFU - SSD FIS/07 Prof. Flavio Di Giacinto

3. BIBLIOGRAPHY

CHEMISTRY / BIOCHEMISTRY
Hein M, Arena S, Foundations of College Chemistry, 14th Edition John Wiley and Sons Inc.
David L. Nelson, Michael M. Cox, Lehninger Principles of Biochemistry, VIII edition, McMillan Learning

PHYSICS Douglas C. Giancoli, Physics: Principles with Applications with Mastering Physics with Get Ready for Physics (6th Edition), Pearson
Additional material, such as exercises and schemes, will be provided to complete, elaborate and update the contents discussed in each module.

4. LEARNING OBJECTIVES

The whole course is aimed at giving the student the principles of physics and chemistry with introduction to biochemistry and basic laboratory activities that are necessary for understanding biomedical sciences.
At the end of the integrated course the student must demonstrate that he/she has reached the following objectives:

Knowledge and understanding abilities – *demonstrate to understand the basic principles of chemistry and physics that are the foundations of the biomedical sciences.*

Applied knowledge and understanding skills – *demonstrate to be able to solve simple chemistry and physics exercises as well as to draw the chemical structures of the more*

important biomolecules

Personal judgement – *the student must properly integrate the knowledge and skills learned showing that he/she has acquired the scientific method approach*

Communication skills – *be able to communicate scientific and applicative content in a clear and unambiguously way, using an appropriate technical language and explaining their personal conclusions, as well as the knowledge and rationale underlying them, to specialists and non-specialist interlocutors.*

Learning ability – *be able to autonomously integrate the information explained during lectures and practicals with the concepts in the text book.*

5. prerequisites

In order to better understand the topics of the course, students must have basic (high school level) knowledge of physics, chemistry and mathematics.

6. TEACHING METHODS

The course is organized into lectures and practical sessions covering the topics included in all the teaching modules to provide the basic elements of Physics, Chemistry, and Biochemistry. The teaching methods implement active learning activities, such as problem-based learning, self-learning, experimental activities, and exercises.
The adopted teaching methods allow students to pursue the learning objectives:

Knowledge and understanding abilities*—All the topics listed in the program will be treated during frontal lectures and carefully explained with tutorials and exhaustive explanations to provide students with the appropriate knowledge and learning method.*

Applied knowledge and understanding skills *– the interactive teaching methods, including practical examples and laboratory practice exercises, will allow students to learn the applicative potential of the treated topics.*

Personal judgment *– the active learning modalities will enable students to formulate ideas independently and use critical reasoning.*

Communication skills *– the active learning modalities will stimulate active and constant interaction with the instructors, towards the progressive development of focused communication skills for the presentation of treated topics through a correct scientific language.*

Learning ability*—Additional material (e.g., scientific articles, and appropriate telematic sources) will support students in their individual and autonomous study.*

7. OTHER INFORMATIONS

The instructors are available for further clarifications and discussions regarding the learning modules' topics and any possible related issues besides the class timetable by appointment.

8. METHODS FOR VERIFYING LEARNING AND FOR EVALUATION

The exam is composed of multiple-choice questions (test items) regarding all modules.
According to Course Regulations (art. 10) students might be assessed through Intermediate Tests. Items to be administered during the Intermediate Tests will address issues related to the content of each discipline (modules) and the number of items for each discipline will be proportional to the number of CFU/hours administered during the course. In order to pass the exam, students must pass all the Intermediate Tests.
The final score obtained in the written test is calculated according to the following scale:
30/n. of test items=18
31/n. of test items=18
32/n. of test items=19
33/n. of test items=19
34/n. of test items=20
35/n. of test items=21
36/n. of test items=21
37/n. of test items=22
38/n. of test items=22
39/n. of test items=23
40/n. of test items=24
41/n. of test items=25
42/n. of test items=25
43/n. of test items=26
44/n. of test items=27
45/n. of test items=27
46/n. of test items=28
47/n. of test items=28
48/n. of test items=29
49/n. of test items=30
50/n. of test items=30 with honors

The minimum score that needs to be achieved to pass the written test is 18.

9. program

<Chemistry/Biochemistry: introduction>
- Introduction to chemistry. The scientific approach to problem-solving in chemistry. The particulate nature of matter. The physical states of matter. Names and symbols of the elements. Introduction to the periodic table. Elements and compounds. Chemical formulas. Conservation of mass. Conservation of energy. Heat. Early atomic theory and structure: Dalton's model. Nature of the electric charge. Ions. Subatomic particles of the atom. Isotopes. Nomenclature of inorganic compounds, common and systematic names.
<Laboratory (safety and health)>
- General description of the safety rules and good laboratory practice. Standards for measurements. Scientific notation. Measure and uncertainty. Significant figures. The metric system. The mole concept. The Avogadro's number. Principles of stoichiometry and chemical reactions.
<Chemistry/Biochemistry >
- Classification of chemical reactions. Chemical Thermodynamics -the Laws of Thermodynamics, Enthalpy, Entropy, Free Energy. Chemical Equilibrium. Equilibrium Constant. Le Chatelier - s Principle. Chemical Kinetics. Reaction Rates. Activation Energy and the Activated Complex. Catalysis. Solutions and their properties. Solubility. Hydrolysis of Salts. Solubility Product. Buffers. Oxidation-Reduction processes. Hydrogen and Oxygen in these processes. Standard Reduction Potentials. Colligative properties. Introduction to Organic Chemistry. Formulas. Naming and Classification of Organic Compounds. Resonance, delocalization, conjugation, and aromaticity. Hydrocarbons and their derivatives: Alkanes, Alkenes, Alkynes, Cycloalkanes. Alcohols. Ethers, epoxides, and sulfides. Amines, ketones and aldehydes. Carboxylic acids, esters and amides. Introduction to Biochemistry. Carbohydrates. Monosaccharides: Classification. Configuration, Optical Activity, Anomers, Epimers. Reactions of Monosaccharides. Glycosidic bond, reducing and nonreducing disaccharides. Polysaccharides, composition and properties. Nucleic Acids, Purine and Pirimidine structures. Lipids and Steroids. Classification, Structure, Properties. Chemical Reactions. Phospholipids and cell membranes. Amino Acids and their properties. Phosphoric acid, inorganic and organic phosphates. Important peptides. Protein structure and function. Globular proteins: Myoglobin and Hemoglobin. Structural proteins: collagen. Membrane proteins and receptors

<Physics I: introduction>
Introduction to Physics; Models theory and laws; Theory of measurements; Units, standards and the International System; One-Dimensional Kinematics; Vectors in Physics; Two-Dimensional Kinematics.
<Physics II: mechanics>
Newton's Laws of Motion. Force and Mass. Applications of Newton's Laws. Free body diagram. Dynamics and Static Equilibrium. Gravity, Friction forces. Elastic force and Hooke law. Momentum.
<Physics III : Thermal physics** and **waves>
Work and Kinetic Energy. Potential Energy and Conservation of Energy. . Molecules and Solids. Fluids. Temperature and Heat. Phases and Phase Changes. The Laws of Thermodynamics. Linear Momentum and Collisions. Waves and sound.
<Physics IV: Electromagnetism>
Electric charges: forces, and fields. Electric potential and electric potential energy. Electric current and direct-current circuits; Magnetism: magnetic flux and Faraday's law of induction. Alternating-current circuits. Electromagnetic waves.
<Electric and electronic measures: Practicals>
A series of basic laboratory experience will cover the following topics: introduction to Estimating Measurement Uncertainty. Overview of primary standards. Measurement of resistance. Principles of operation of digital multimeters and calibrators. Measurement of direct voltage and current. Principles of calibration. Measurement of voltage and current. Reporting calibration data and uncertainties.
<Laboratory (safety and health): Practicals>
- A series of basic laboratory experience will cover the following topics: measuring mass and volume, measuring temperature, quantitative composition of compounds. Definition of solution.
<Chemistry/Biochemistry: Practicals >
- A series of basic laboratory experience will cover the following topics: titration of a strong acid using a strong base, titration of a weak acid using a strong base. Equivalence point. Buffer solutions.