ACADEMIC YEAR 2023/2024

General information	
Name of the integrated course	**PHYSICS, CHEMISTRY AND PROPEDEUTIC BIOCHEMISTRY**
Integrated teaching modules	**Medical Chemistry 4ECTS** **Biochemistry 5ECTS** **Medical Physics 2ECTS**
Degree course	Single cycle degree in Veterinary Medicine (LM42)
Academic Year	I
European Credit Transfer and Accumulation System (ECTS)	5 (ECTS lessons: 4; ECTS labr: 1)
Language	Italian
Period of teaching	I bimester
Attendance	Mandatory

Professors/ Lecturers	**e-mail address**	**telefono**
Andrea Listorti	andrea.listorti@uniba.it	080 5442009
Vito Porcelli	vito.porcelli@uniba.it	0805442772
Roberto Cilli	roberto.cilli@uniba.it	080 544 2342 327 730 8761

Headquarters	Campus of Veterinary Medicine, S.P. per Casamassima km 3, 70010 Valenzano
Virtual headquarters	Microsoft Teams (team code) Porcelli: 8y13qi4 Listorti: 0om5alr Cilli: xl2rwhu
Tutoring (time and day)	Listorti: Tuesday-Friday 11.00-13.00/15.00-17.00, from Monday to Friday by appointment via email or telephone call Porcelli: Friday 9:00-11:00 am 3:00-4:00 pm by appointment via email Cilli: From Monday to Friday by appointment via email or phone call

Syllabus	
Learning Objectives	The integrated modules of Chemistry and Propaedeutic Biochemistry aim to provide the basic knowledge of chemistry, emphasizing those principles that are most relevant for the profession, including the study of the characteristics of the elements and the formation of bonds that constitute organic molecules complex. Starting from this basis, the student will have to acquire a good knowledge from a structural and functional point of view of the most important classes of biological macromolecules (proteins, carbohydrates, lipids and nucleic acids). This approach will allow the student to have the basis for the study of metabolic biochemistry and the chemistry of biological compounds. Finally, the course aims to impart information relating to the main laboratory techniques for the qualitative and quantitative study of biological molecules in the medical-veterinary field. The integrated Medical Physics module aims to show some applications of physics methods in the context of biological systems.
Course prerequisites	No prerequisites. It is helpful to have a good understanding of basic mathematics.

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Contents of the teaching module: **Chemistry** Teacher: **Andrea LISTORTI** **Lectures** **ECTS: 4** **Hours: 32**	The course belongs to the Basic Subjects Introduction to the course: chemistry for veterinarians. The atomic model of matter. The electronic model of the atom and the periodic properties. -The electronic model of the hydrogen atom. The electronic configuration of polyelectronic atoms. Periodic properties. The classification of elements in metals and non-metals -Chemical bonds. -The covalent bond. The ionic bond. The metallic bond. Intermolecular interactions -States of aggregation of matter. - Model and properties of the solid state. The models and properties of the liquid and gas states Transitions and state diagrams for one-component systems. - State transitions and principles of thermodynamics. Single component state diagrams. Multi-component systems. - Solutions and solution properties -Chemical reactions and stoichiometry. The equilibrium and thermodynamics of gas phase reactions. The kinetic properties of the reactions. The acid-base and solubility equilibria in aqueous solution. Electrochemistry: redox reactions and electric potential.
Contents of the teaching module: **Medical Physics** Teacher: **Roberto CILLI** **Lectures** **ECTS: 2** **Hours: 16**	• **MECHANICS OF SOLIDS.** ➢ Newtonian mechanics and Newton's laws. ➢ Principles of statics. ➢ Balance of levers. ➢ Elastic and plastic deformations: Hooke's Law, ➢ Young's Modulus and Hysteresis Cycles. ➢ Elements of biomechanics. • **ACOUSTIC WAVES.** ➢ Waves and periodic motion. ➢ Acoustics ➢ Propagation of Force and Pressure waves in media. ➢ Hearing in mammals. ➢ Biomedical applications of ultrasound. • **THERMODYNAMICS.** ➢ Heat and temperature. ➢ The principles of thermodynamics. ➢ Biological thermodynamics and Gibbs free energy. • **GEOMETRIC OPTICS.** ➢ Light radius and geometric optics approximations ➢ Snell's Laws ➢ thin lens approximation. ➢ Magnification power of a lens.

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	➢ Geometric aberrations (Barrel and Pincushion). ➢ Human eye and diopters. • **MECHANICS OF SOLIDS.** ➢ Newtonian mechanics and Newton's laws. ➢ Principles of statics. ➢ Balance of levers. ➢ Elastic and plastic deformations: Hooke's Law, ➢ Young's Modulus and Hysteresis Cycles. ➢ Elements of biomechanics. • **ACOUSTIC WAVES.** ➢ Waves and periodic motion. ➢ Acoustics ➢ Propagation of Force and Pressure waves in media. ➢ Hearing in mammals. ➢ Biomedical applications of ultrasound. • **THERMODYNAMICS.** ➢ Heat and temperature. ➢ The principles of thermodynamics. ➢ Biological thermodynamics and Gibbs free energy. • **GEOMETRIC OPTICS.** ➢ Light radius and geometric optics approximations ➢ Snell's Laws ➢ thin lens approximation. ➢ Magnification power of a lens. ➢ Geometric aberrations (Barrel and Pincushion). Human eye and diopters.
Contents of the teaching module: **Structural Biochemistry** Teacher: **Vito PORCELLI** **Lectures** **ECTS: 5 (4+1)** **Hours: 42 (32+10)**	Introduction to organic chemistry: Alkanes: Nomenclature. Position and conformational isomerism. Cycloalkanes. Conformational and geometric isomerism in cycloalkanes. The reaction mechanisms. The concept of electrophile and nucleophile. Carbocations and carbanions. Alkenes and alkynes: Nomenclature. Geometric isomerism. Electrophilic addition reactions to alkenes: general mechanism. Addition reactions: hydracids and water. Stereochemistry of oxidation reactions. Notes on the polymerization reactions of alkenes. Aromatic hydrocarbons Benzene: structure, aromaticity and stabilization energy. Optical Isomerism: Chirality. Enantiomers, racemes and diastereomers. Chiral carbons. Basics Alkyl Halides: Nomenclature. Alcohols and Glycols: Nomenclature. Acidity of alcohols. Alcoholics. Dehydration of alcohols to alkenes (E1 mechanism). Oxidation of alcohols to carbonyl compounds. Glycols and glycerol: synthesis and properties. Nucleophilic addition reactions to carbonyl: Acetals and hemiacetals, Aldimmines and Schiff bases. Enols and enolates: keto-enol tautomerism and its importance in metabolic processes. Carboxylic Acids: Nomenclature. Carboxyl structure. Acidity. Esterification. Acyl halides and anhydrides: synthesis and reactions. Reduction reactions. Fatty acids and their salts. Foreign: Nomenclature. Fisher's esterification. Saponification. Soaps. Reactions of formation of the carbon-carbon bond: Aldol condensations. Similarity between Claisen condensation and that of thiolesters. Amino Acids and Proteins: Classification of amino acids. Peptide bond. Proteins: primary, secondary, tertiary and quaternary structure. Functional classification of proteins: catalytic, supporting, transport, hormones. Amino acid derivatives: biogenic amines Carbohydrates (simple and complex): Sugars: Aldoesosis and Ketoesosis. Epimers. Glucosides and their biological importance. Pentosis and N-ribosides.

	Glucosamines. Disaccharides: maltose, cellobiose, lactose, sucrose. Oligosaccharides. Polysaccharides: starch, cellulose, glycogen and their structure. Glycoproteins: structure and classification: immunoglobulins, milk and plasma glycoproteins and blood groups. Lipids: classification and biological functions. Simple lipids: fatty acids, saturated and unsaturated fatty acids. Isomerization. Triglycerides. Saponifications. Micelles and soaps. Oxidative rancidity. Phospholipids, glycolipids and lipoprotein systems of particular medical-veterinary interest. Prostaglandins and steroids. Phenolic antioxidants, ascorbic acid and carotenoids Nucleic acids: purine and pyrimidine bases, nucleotides and nucleic acids: DNA (nDNA and mtDNA), RNA (mRNA, tRNA) Micronutrients: water-soluble and fat-soluble vitamins, structure, biological action, mechanism of action, hypo and hypervitaminosis. Enzymes: nomenclature and classification, structure, active sites and enzymatic specificity, enzymatic kinetics and regulation. Inhibitors and their mechanism of action. Main reactions catalyzed by enzymes. Biochemical laboratory techniques: Preparation and manipulation of biological samples. Buffers used in biochemistry. Spectrophotometry: Properties of electromagnetic radiation, atomic and molecular absorption spectra, Lambert-Beer law, classification of spectrophotometers: single beam, double beam and double wavelength; Structure and function of: sources, monochromators, sample holders and detectors; measurement of the molar extinction coefficient, dosage of enzymatic activity and dosage of a substrate in biological sample. Chromatographic techniques: classification and principles. Factors influencing the chromatographic process: partition coefficient, capacity factor, selectivity factor and column efficiency. Chromatography by partition, ion exchange, molecular exclusion and affinity. Immunochemical techniques, Immunoprecipitation. Western blotting analysis of a protein sample.

Biosafety rules for the attendance of practical activities.	Access to the laboratories is allowed only to students equipped with protective clothing (lab coats or disposable latex gowns and gloves), who have read the biosecurity manual

Materail for the personal study	
Books and bibliography	**Medical Chemistry** I. Bertini, C. Luchinat, F. Mani. "Chimica: materia, tecnologia, ambiente". Casa Editrice Ambrosiana. Distribuzione esclusiva Zanichelli. **Structural Biochemistry** *Chimica e Propedeutica Biochimica - F. A. Bettelheim, W. H. Brown, M. K. Campbell, S. O. Farrell, O. J. Torres - EDISES* **Medical Physics** Giancoli, Douglas. Fisica con Fisica Moderna. Casa Editrice Ambrosiana. ISBN 9788808186102. Class notes; PDF presentations available in Google Drive and Microsoft Teams
Additional materials	The additional teaching material will be provided by teachers at the beginning of the course and will be available in the Microsoft Teams platform.

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Work schedule			
Hours			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Individual study
275	80	10	185
ECTS			
11	10	1	/

Teaching strategy	Lectures and exercises are traditionally presented by the teacher in the classroom (no e-learning mode) that are provide of computers connected on-line. The laboratory experience will be done in small groups of students, the principal techniques in the field of biochemistry will be performed under the supervision of teacher.

Expected learning outcomes	
Knowledge and understanding ability	At the end of the course, the student will acquire knowledge and understanding relating to: • understanding of the composition and properties of matter and the chemical transformations that involve it. • (re)know the structure, function and reactivity of the main biological macromolecules such as carbohydrates, lipids, proteins and nucleic acids; ii) know the application of the biochemical laboratory techniques most closely related to the medical-veterinary field for the quantitative and qualitative study of biological macromolecules. • understanding of biological systems through simplified models inspired by Classical Physics.
Applied knowledge and understanding ability	At the end of the medical chemistry course the student will have integrated their basic knowledge on the natural phenomena that concern the transformation of matter; will have a complete overview of the laws that regulate the structure of the atom, molecules and compounds; will know the theoretical reasons underlying energy balances during the transformations of matter. At the end of the Medical Physics module the student will acquire autonomous learning, abstraction and logical reasoning skills that can be applied especially in the biological field. At the end of the Structural Biochemistry course the student will: i) be able to correlate the molecular mechanisms of the various classes of organic molecules with the complex structure of biological macromolecules; ii) be able to identify the appropriate biochemical laboratory technique for the study of various biological molecules
Soft skills	**Making informed judgments and choices** ○ the course will provide general tools allowing the students to critically solve problems concerning basic knowledge of physics, chemistry and structural biochemistry. **Communicating knowledge and understanding** At the end of the course, the student will: ○ possess the bases for a scientifically sounding communication with respect to the transformation of organic and inorganic matter. **Capacities to continue learning.** At the end of the course, the student must be able to:

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	○ have the possibility to independently improve his understanding and mastering of natural phenomena involving bio-chemical transformations.
Summary of the knowledge and competences that the integrated course concurs to let the students acquire (Day One Competences) as scheduled by EAEVE	**DOC 2.11** **DOC 2.2**

Assessment and feedback	
Methods of assessment	For the medical chemistry and structural biochemistry modules, knowledge assessment takes place through an oral test on the program topics. For the medical physics module Knowledge is assessed through a written test on the program topics.
Evaluation criteria	• **Knowledge and understanding:** The student must be able to explain the different topics addressed in the course in a simple, clear and rigorous way. • **Applied knowledge and understanding:** - The student must be able to make a balance of spontaneity of chemical and electrochemical processes and quantify the mass and energy at play during these transformations. - The student must be able to correlate the role of the main functional groups to biological macromolecules and to apply the appropriate laboratory technique to study them. - The student must be able to describe and justify the physical laws that govern physical systems. • **Autonomy of judgement:** The student must be able to independently organize a large speech that illustrates a specific process using all the knowledge acquired. • **Communication skills:** The student must be able to use the appropriate scientific terminology in a clear and simple manner, understandable even to those without in-depth knowledge of the subject. • **Ability to learn:** The student must be able to correlate the notions acquired by integrating and harmonizing them with the concepts previously acquired in other related disciplines.
Criteria for assessment and attribution of the final mark	The exam of the integrated course of "PHYSICS, CHEMISTRY AND BIOCHEMISTRY" includes a partial test relating to the modules of "Physics" and "Chemistry" and a subsequent one of "Introductory biochemistry". The final grade is the result of the collegial judgment relating to the two partial tests in which the student must demonstrate that he has acquired a critical sense with respect to the topics studied. The final evaluation, expressed in thirtieths, will be considered passed with a grade equal to or higher than 18 and will take into consideration not only the accuracy of the answer, but also the communication skills, the clarity of presentation, the disciplinary competence and the level of in-depth analysis.

Other comments	Students are required to attend 75% of the lectures and laboratory lessons (where applicable).

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