SYLLABUS: GENERAL CHEMISTRY (IC CHEMISTRY AND STRUCTURAL BIOCHEMISTRY)

GENERAL CHEMISTRY (3 CFU; 27 hours – 19 T + 8 Ex) **Learning objectives: at the end of the course, the students know basics of general chemistry, which are essential for the understanding at molecular level the biological mechanisms which take place in cells and animals and for developing of professional skills in veterinary medicine area.**			
Matter and developed skills	**Topics**	**Specific contents**	**N of hours**
OPENING LESSON (1 HOUR)		*Course introduction, illustration of the program of the course and of examination and assessment methods*	1
1. DESCRIPTION OF MATTER AND BIOLOGICAL SYSTEMS AT ATOMIC AND MOLECULAR LEVEL (5 HOURS) (skills in: *a) correct nomenclature in describing structure and properties of inorganic substances of biological interest;* *b) understanding states and properties of biological systems through atomic and molecular structure;* *c) foreseeing molecular shape and polarity to understand interactions of biological interest as solubility, diffusion through membrane, ecc.*)	***Fundamentals.***	International System of Units. Properties and classification of matter. Thermodynamic system. Energy, work, heat and temperature.	1
	Atoms: from electronic structure to properties of matter.	Atomic structure. Subatomic particles. The mole concept and mole calculations. Electronic configurations and atomic properties. The periodic table; groups and trends.	2
	Interactions among atoms: chemical bond and matter properties.	Chemical bond and bond energy. Covalent bond. Electronegativity and polar bond. Ionic and metallic bond. Coordination complexes of biological interest. Lewis dot formulas. Mesomeric effect. VSEPR theory: molecular geometry, polarity and importance in chemical-biological interactions. Weak bonds and biological importance.	2
2. REACTION DYNAMICS: (TOT. 4 HOURS) (*skills in correctly describing and understanding chemical-biological processes and mechanisms through equilibrium and, thermodynamic concepts*)	***Chemical reactions and stoichiometry.***	Balancing chemical equations and stoichiometry. Acids and bases. Acid-base and redox reactions of biological interest. Solution concentration and stoichiometry.	1
	Thermodynamics and bioenergetics.	Thermodynamics and bioenergetics. Energy conservation. Laws of thermodynamics. Enthalpy: calorimetry and fuel values of food. Entropy. Gibbs free energy and spontaneous reactions. Biochemical standard state. Coupled biochemical reactions.	1
	Chemical kinetcs and equilibrium.	Rates of reactions. Energy of activation. Concentration, temperature, catalysts. Arrhenius equation. Catalysis. Equilibrium conditions and constants. Effects on equilibrium.	2

3. SOLUTIONS: PROPERTIES AND EQUILIBRIA IN AQUEOUS SYSTEM OF BIOLOGICAL INTEREST (TOT. 7 HOURS) *(developing skills in thinking through and understanding biological processes in aqueous solutions)*	***Solutions and properties.***	Aqueous solutions: mechanisms of solubilisation processes and solubility. Colligative properties, with special concern for osmotic pressure. The organic solvent. Hydrophobic interactions: nature and biological interest.	2
	Equilibria in aqueous solutions.	Homogeneous and heterogeneous equilibria. Equilibrium constant of solubility product. Autoionization of water. pH. Strength of acids and bases. Hydrolysis: predict pH of a salt solution. Buffer solutions. Amphoteric electrolytes: isoionic and isoelectric pH. Measuring pH: pH indicators and pHmeter.	5
4. BIOCHEMISTRY OF INORGANIC ELEMENTS AND COMPOUNDS OF BIOLOGICAL INTEREST (TOT. 2 HOURS) *(skills in understanding and foreseeing properties of elements and compounds of biological interest.)*	***Properties and role of essential elements in animal organisms.***	Essentiality and bioavailability concepts; macroelements, microelements and toxic elements; relationship between structure, properties, bioavailability and role in animal organisms.	1
	Oxygen as example of relationship between structure, reactivity and biological role.	Allotropic forms and oxygen radical species. ROS (reactive oxygen species): production, reactivity and contribution to oxidative stress.	1
5. LAB ACTIVITY ***Start-up in chemical-biochemical lab (TOT. 5 HOURS)*** *(skills in working safely in research laboratory, both individually and in groups, and in processing data critically)*	***Safety in lab***	Training in working safely in laboratory. Standard safety practice. Evaluating acquired skills: multiple-choice test.	1
	Calculating solution concentration	Calculating concentrations: concentration units and dilutions through problem solving approach.	1
	Elementary chemistry laboratory	Laboratory glassware: description and correct use. Preparation of aqueous solutions and dilutions.	2
	Measuring pH	The pHmeter: concept of instrument; measure of pH in aqueous solutions.	1
6. LAB ACTIVITY ***Analysis of equilibria in aqueous solutions through problem solving approach (TOT. 3 HOURS)*** *(skills in critical thinking and problem solving)*	***Acid-base homeostasys***	Buffer solutions: preparation and use. Buffer solutions of biological interest: blood buffering system.	1
	Solubility	Gas solubility in blood. Solubility constant product in understanding Ca compartmentation in organisms.	1
	Osmotic pressure and importance for animal organisms	Diffusion through selective membranes. Concentration gradient concept: discussion on examples of biological interest.	1