Atomic Structure and Chemical Bonding

1. **Course number and name:** 020ATONI2 Atomic Structure and Chemical Bonding

2. **Credits and contact hours:** 2 ECTS credits, 1x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Marie-Jose Zacca, Samar Kaddah, Tala Kanson, Fadel Chamsseddine, Roger Matta

4. **Instructional materials:** Course handouts; in-class problems

5. **Specific course information**
   a. **Catalog description:**
   This course begins with a history on atomic sciences. It allows students to master the emission and absorption spectra concepts. Then the hydrogenoids (atom with one electron) will be explained before the polyelectronic atoms. A basis on bonding in isolated molecules – Simple Theories (Lewis + VSEPR) is covered. In the last part ionic and covalent bonds, molecular interactions and the periodic table are explained in details. After each part covered, tutorials are given in order to master the concept and know how to apply it and make the necessary calculations.

   b. **Prerequisites:** None

   c. **Required/Selected Elective/Open Elective:** Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
   - Have a historical approach to the structure of the atom: work done by Dalton, Thomson, Rutherford, etc.
   - Know the constituents of the atom, the atomic mass unit and the chemical element.
   - Calculate the atomic molar mass and size of an atom or ion.
   - Mater the emission and absorption spectra (the quantification of electronic energy).
   - Have an idea about quantum mechanics and wave-particle duality.
   - Know Schrodinger's equation and the wave function.
   - Study the hydrogen atom in quantum mechanics.
   - Being able to describe an electronic state: quantum numbers (n, l, m_l, m_s).
   - Represent atomic orbitals and write the electronic configuration of an atom.
   - Apply the Hund and Klechkowsky rules and the Pauli Exclusion Principle.
   - Distinguish between valence electrons and core electrons.
   - Write the electronic configuration of an ion/atom and classify it in the periodic table of the elements.

- Know element families and exceptions to filling rules.
- Evolution of some atomic properties.
- Know how to define and classify the elements according to ionization energies, electron affinity and Electronegativity.
- Apply the octet rule and represent simple atoms and molecules according to Lewis.
- Know how to find the total number of electrons and valence pairs in a molecule and calculate the formal charge.
- Know how to describe chemical bonds (polarization of a bond, bond energy, bond length).
- Apply the principle of the VSEPR method to know the geometry of molecules and the interactions between polar molecules.

b. PI addressed by the course:

PI	1.3	3.2	7.1
Covered	x	x	x
Assessed	x	x	

7. Brief list of topics to be covered

- Chapter 0: Introduction: Historical approach to the structure of the atom (1 lecture)
- Chapter 1: Elementary constituents of the atom (2 lectures) + Exercises (1 lecture)
- Chapter 2: Introduction to quantum mechanics (2 lectures) + Exercises (2 lectures)
- Chapter 3: The chemical bond and the electronic structure of molecules (3 lectures) + Exercises (1 lecture)