COURSE ID SHEET

Course No.	5122	NTUA

Semester:	1	Core	X	Elective		Specialization	

Title: **INORGANIC CHEMISTRY**

Aim:

The course deals with: i) the structure of the atoms; ii) the periodicity of their physical and chemical properties; iii) the types of chemical bonds; iv) the structure and geometry of the molecules; and v) the macroscopic behavior of materials in connection with their molecular structure. In addition to teaching, the course also includes individual laboratory training of students. Students are trained in basic experimental technics, in a lab scale approach of some chemical engineering processes and also in good laboratory practices and application of safety rules in the chemical lab.

Content:

- Fundamental particles of an atom: Electrons - Protons - Neutrons. Thomson, Rutherford, Bohr and Sommerfeld models.
- The wave nature of electrons: Quantum theory. Uncertainty principle (Heisenberg's uncertainty principle). Schrödinger equations. Atomic orbitals. Quantum numbers.
- Periodic Table: Structure of Periodic Table. Periodic trends of the properties of elements.
- Ionic bond: Transfer of valence electrons. Lattice energy and Born-Haber Circle. Polarizability of bonds.
- Covalent bond - Electron pair bonds: Lewis structure. Octet rule. Formal charge. Resonance. Bond properties. VSEPR Theory.
- Covalent bond – Wave mechanics approach: Valence bond theory. Hybridization. Molecular orbital theory. Homonuclear and heteronuclear diatomic molecules.
- Crystal structure and metallic bond: Metallic character. Crystal systems. Free electron theory of metals. Band Theory.
- States of matter and intermolecular forces: Kinds of intermolecular forces. Dipolar moment and polarity of molecules. Intermolecular forces in gases and liquids. Phase diagrams. Crystalline solids.
- Modern applications of Inorganic Chemistry.

Laboratory Exercises:

- Identification and appropriate use of laboratory equipment. Searching of data. Use of handbooks.
- Methods of separation and purification of substances.
- Preparation of crystal ($PbCl_2$, PbI_2) and colloidal ($Fe(OH)_3$) precipitates - Separation via filtration and centrifugation.

Crystallization – recrystallization:

- Separation of solids (KNO_3 – $Cu(NO_3)_2$) by fractional crystallization.
- Separation of solids by sublimation.
- Separation of liquids by distillation (CCl_4 -CH_3COOH).
- Distillation of azeotropic mixture HCl - H_2O.
- Occlusion - Purification of $Al(OH)_3$ from sulfates.
- Purification of NaCl.

Preparation - properties of solutions:

- Heat release during the dissolution of substances.
- Cryogenic systems.

- Color affect upon dissolution.
- Volume change during mixing of substances.

Preparation of ionic and molecular bonding compounds:

- Preparation of $BaCl_2$ x H_2O. Determination of x.
- Preparation of NaCl and KNO_3.
- Preparation of I_2.
- Preparation of $FeCl_3$, ICl.
- Preparation of K-Al.

Inorganic materials:

- Glass processing.
- Synthesis of Cu by reducing of CuO with natural gas.
- Synthesis of Cu by reducing of CuO with lignite.
- Synthesis and analysis of Sn-Sb alloys.
- Synthesis of $Al_2(SO4)_3$ from kaolin.
- Synthesis of silica sensors by using sol-gel technique.

Hours per semester:

LECTURES	**39**	EXERCISES	**-**	LABORA-TORY	**65**	HOME-WORK	**106**	**TOTAL HOURS: 210**

Student performance/ evaluation:

Written examination (50% of the final mark).
Performance in the lab, evaluation of the written reports (50% of the final mark).