KTT 111/3 – Inorganic Chemistry I

Course Objective: To provide students with the basic knowledge of stoichiometry, periodic table, atomic structure, bonding in molecules and basic nuclear chemistry.

Topic	**Content**	**Number of lecture hours**	**Expected outcome – upon completion of this course, the student should be able to:**
1. Stoichiometry	• Basic laws of chemistry • Significant figures • The mole concept and stoichiometry • Empirical formula • Molecular formula • Structural formula • Percent composition • Acid-base titration problems • Balancing oxidation-reduction reactions • Oxidation-reduction problems	5	• Understand the basic laws of chemistry. • Explain clearly the terms: element, compound and mixture. • Write the formula for elements and compounds. • Compute problems to the correct significant figures. • Know the relationship between the mol, mass and Avogadro's number and use them in solving stoichiometric problems. • Determine the empirical formulae of compounds. • Determine the molecular formulae of compounds. • Determine the percentage composition of specified entities in a given molecular formula or ionic formula. • Balance oxidation-reduction reactions and apply them in solving stoichiometric problems. • Solve any stoichiometric problem.

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2. Periodic Table	• Mendeleev's contribution to the development of the periodic table • Modern periodic table • The long form of the periodic table • The periodic arrangement of the elements in the periodic table • The relationship between the groups and the number of valence electrons of the elements	3	• Know the historical origin of the periodic table. • Know the basis for the modern periodic table. • Name inorganic compounds. • Identify the elements in the groups: alkaline, alkaline earth metals, calcogens, halogens, noble gases, transition metals and the inner transition metals. • Write the relationship between the elements in the group and in a particular period.
3. Electrons in Atoms	• Electromagnetic radiation • Bohr's atomic theory • de Broglie's concept of the dual nature of matter • Schrödinger's wave equation and the appearance of the quantum numbers **n**, **l** and $\mathbf{m_l}$ • Energy levels in atoms • The spin quantum number, **s** • The periodic table and the relationship with the electronic configuration of elements • The shapes of **s**, **p**, **d** and **f** orbitals • The concept of effective nuclear charge • The periodic properties of the elements	6	• Write the relationship between wavelength, frequency and the speed of light. • Know and identify the colours in the electromagnetic radiation. • Differentiate between the continuous and line spectra. • Use the Rydberg equation to calculate the wavelength or the frequency of an observed line in the hydrogen line spectrum. • State the assumptions of Bohr's atomic theory and derive Bohr's equation for the energy of the electron in the hydrogen atom. • State the reasons for the failure of Bohr's theory and relate it to Heisenberg's uncertainty principle. • Explain the natural quantization of energy using the standing wave. • Differentiate between orbit and orbital.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
			• Write the values for **n**, **l**, $\mathbf{m_l}$ and **s** for a given electron in a particular orbital. • Write the ground state electron configuration of any element in the periodic table. • Use the periodic table to predict the electron configuration of elements. • Draw and describe the shapes of **s**, **p**, **d** and **f** orbitals. • Understand the concept of “effective nuclear charge”. • Explain the periodic variation of atomic properties – variation of atomic and ionic size and ionization energy. • Explain the irregularities in the periodic variation of the ionization energy and electron affinity.

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4. Nuclear Chemistry	• The conservation of mass and energy in all of their forms • Einstein's mass/energy relationship • Nuclear binding energy • Binding energy per nucleon and nuclear stability • Radioactivity and emission of particles by unstable atomic nuclei • Transmutation • First order radioactive decay process • Calculations of half-life • Radiological dating • Uses of radioactive nuclides • Nuclear fusion and fission	5	• Use Einstein's mass energy equation $E = mc^2$ to relate the mass energy relationship. • Calculate the nuclear binding energy for a given atom. • Explain the radioactive decay in terms of the instability in the nucleus. • Write balanced nuclear reactions. • Convert between energy units – the electron volt and joule. • Explain the terms: radioactive disintegration series, positron emission, β-emission, α-emission, γ-emission, antimatter, neutron emission and electron capture. • Explain how radioactive nuclei try to fall within the belt of stability. • Know what happens during transmutation. • Calculate half-life and the age of a given radioactive material (radiological dating) – i.e. C-14 dating. • Know the uses of radioactive nuclei in medicine and in chemistry. • Calculate the heat energy from the fusion and fission processes.

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5. Bonding	• Electron transfer and ionic compounds • Lewis structure • Covalent bond and partial charges • Formal charge • Resonance structure • Molecular shapes and VSEPR model • Valence Bond Theory • Molecular orbital theory	6	• Understand the basis of chemical bond formation. • Understand the concept of electron sharing in covalent bond formation. • Draw the electron dot representation for covalent compounds. • Assign formal charges and predict the geometry of molecules using the electron pair repulsion principle. • Explain the geometry of molecules using the concept of hybridization. • Understand the concept of the linear combination of atomic orbitals (LCAO). • Draw the relative molecular orbital energy diagram. • Draw the Born Haber Cycle diagram and use it to calculate the electron affinity or the lattice energy in an ionic compound.

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6. Structure, Properties and Application of Solids	• Crystalline solids and ordered internal structure • Unit cells and crystal structure • Stoichiometry and packing of atoms in a unit cell • Physical properties and crystal types • Band theory • Macromolecules or polymers • Inorganic polymers • Modern ceramics • Nanotechnology and molecular structure	5	• Understand the various unit cells that make the crystalline solids. • Determine the cationic or anionic coordination number from radius ratio calculation. • Calculate the density of a solid and the atomic radius from unit cell dimensions, space group and atomic mass of element present in the solid. • Explain the band theory and relate it to the electronic structure of solids. • Distinguish between organic and inorganic polymers. • Explain the formation of polymers using monomer units and various reaction processes in its synthesis. • Understand the need for the development of modern ceramics to meet specific requirements of materials. • Understand the sol-gel process in the formation of ceramic materials. • Understand the nano-composite materials and their special properties.
	TOTAL	**30**	