

THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
CHEMISTRY 1000 COURSE OUTLINE

FIRST SEMESTER

TOPIC	SUB TOPICS
Stoichiometry, Gases	<p style="text-align: center;"><u><i>Stoichiometry</i></u></p> <ul style="list-style-type: none"> • Measurement: Units of measurement, Uncertainty in measurement - Accuracy and Precision, Dimensional analysis Relative masses of atoms and molecules, determination of relative atomic masses from percentage composition, Empirical and molecular formula, combustion analysis The mole, Avogadro's number, Quantitative information from balanced reaction, limiting reactant, theoretical yield, percentage yield. • Solution Stoichiometry: Types of reaction: Precipitation reaction – metathesis, Acid-base reaction - acids, bases, neutralisation reactions, acid-base reaction with gas formation Oxidation - reduction reaction- oxidation, reduction, oxidation numbers, Balancing redox reaction by oxidation number method and by ion electron method in acid and basic medium; Concentrations of solutions: molarity, dilution, Titration: simple titration, back titration and redox titration, <p style="text-align: center;"><u><i>Gases</i></u></p> <ul style="list-style-type: none"> • Postulates of kinetic theory, Use kinetic theory to explain gas laws; the ideal gas behaviour and deviations from it (behaviour of real gases - the van der Waal's equation); Use of ideal gas equation in determining the molar mass

Atomic structure and the periodic Table	<ul style="list-style-type: none"> • <u>Atomic structure</u>: The nucleus of the atom: neutron, proton, isotopes, proton and nucleon number, mass number; Bohr's model of atom, Rhydberg's equation, Idea of de Broglie matter waves; Heisenberg uncertainty principle, atomic orbitals, quantum numbers, Aufbau and Pauli's exclusion principles. Hund's multiplicity rule; electronic configuration of elements; effective nuclear charge and shielding; shapes of s and p orbitals and their characteristics. • <u>Periodic Trends</u>: Atomic and ionic radii, ionization energy, electron affinity and electronegativity – definition, trends in periodic table and applications in predicting and explaining the chemical behaviour.
Chemical Bonding	<ul style="list-style-type: none"> • Ionic bond, covalent bond and coordinate bonds, Lewis structure, formal charge, directional characteristics of covalent bond Hybridization (sp, sp², sp³) and shapes of simple molecules and ions by valence shell electron pair repulsion (VSEPR) theory, Resonance structures, Molecular orbitals: bond order; bond length, bond polarities, intermediate nature of bonds, dipole moment.
Electrochemistry	<ul style="list-style-type: none"> • Redox process: electron transfer and change in oxidation state; • Standard electrode potentials, the redox series, cell potentials under standard and non standard conditions, the Nernst equation, concentration cells; Batteries and fuel cells Corrosion; Electrolysis, factors affecting amount of substance liberated during electrolysis, The Faraday constant;
Thermochemistry	<ul style="list-style-type: none"> • First and second law of Thermodynamics; Heats of reaction, Calorimetry, Enthalpy, Hess's Law, Bond Energy, Lattice Energy

SECOND SEMESTER

TOPIC	SUB TOPIC
Chemical Kinetics	<ul style="list-style-type: none"> • Rate of reaction, average rate, instantaneous rate, initial rate, • Factors affecting rate – concentration, particle size, temperature, catalyst; • Rate laws, rate constant and its units; Integrated rate law equations for zero order, first order and second order reaction; Half-life, linear relations of integrated rate equations, • Temperature dependence of rate constants and Arrhenius equation; • Activated complex theory (ACT) and Collision theory
Chemical equilibrium	<ul style="list-style-type: none"> • Homogenous equilibrium: Gas-phase equilibrium; equilibrium constants; K_c and K_p relationships; relationship between equilibrium constant and Gibbs energy; Factors affecting chemical equilibrium; Le Chatelier Principle. Solubility and solubility products, common ion effect.
Acid-base equilibrium	<ul style="list-style-type: none"> • Definition of acids and bases; strong and weak acids and bases; Equilibrium constants; pH and pOH of acids and bases; Hydrolysis of salts of weak acids and bases; Buffers; Indicators; Titration curves.
Phase equilibrium	<ul style="list-style-type: none"> • One-component phase equilibrium-phases diagram of water and carbon dioxide; Clausius-Clapeyron equation.
Intermolecular forces	<ul style="list-style-type: none"> • van der Waal's forces, dipole-dipole interaction, hydrogen bonding; bonding and physical properties – vapour pressure, boiling point, melting point, solubility.
Solutions and their properties	<ul style="list-style-type: none"> • Types of solutions: saturated, unsaturated, and supersaturated solutions; non-electrolytes and electrolytes; solubility of nonvolatile solutes, solution of volatile solute and solvents, solubility of gases in liquids -

	<p>Henry's law; the v'ant Hoff equation; vapour pressure of a solution with a volatile solvent and non-volatile solute (Raoult's Law); vapour pressure of a solution of a volatile solute and volatile solvent; colligative properties: vapour-pressure lowering, boiling-point elevation, freezing point depression, and osmotic pressure.</p>
<p>Organic Chemistry</p>	<p>Organic chemistry, and why study organic chemistry? Hybridization of carbon and bonding in organic compounds Elemental composition and classification of organic compounds Hydrocarbons: Molecular and structural formulae; Expanded (Lewis), condensed and line-bond (skeletal) presentations, nomenclature (IUPAC and trivial), classification of carbons and hydrogens, structural isomerism, physical properties of alkanes (acyclic and cyclic), alkenes (acyclic and cyclic) and alkynes Aromatic hydrocarbons: Resonance, nomenclature (IUPAC and trivial), classification of carbons and physical properties Functional groups in organic chemistry: Structure, nomenclature and priority (suffixes and prefixes) of haloalkanes, aminoalkanes, nitroalkanes, alcohols, ethers, ketones, aldehydes, nitriles carboxylic acids, esters, and amides The importance of Index of hydrogen deficiency (IHD) or Degree of Unsaturation (DU); its calculation and interpretation Reactions: Definition of a reaction, Substitution and addition, radicals, carbocations, electrophiles and nucleophiles and the curly arrows and half arrows for movement of electrons Reactions of alkanes: Combustion of hydrocarbons and Halogenations' of alkanes.</p>

