Chemistry

Introduction - Periodic Table of Elements and inorganic nomenclature.

Atom – Structure. Isotopes. Electrons and atom electronic configuration. Quantic numbers and orbitals. Auf-bau. Chemical bonds.

Aggregation states of matter - Gases: state equation of ideal gases. Absolute temperature and its relationship with average molecular velocity. Gasous mixtures; law of Dalton. Liquids: vapour pression of a liquid. Solids: structural characteristics of covalent, ionic, molecolar, and metallic solids.

Chemical thermodynamics – State functions. Internal energy. Enthalpy and law of Hess. Entropy. Free energy; correlation with enthalpy and entropy.

Solutions - Concentration of a solution. Diluition and mixing of solutions. vapour pressure of solutions (law of Raoult). Colligative properties. Gas solubility in liquids: law of Henry.

Chemical equilibrium – Equilibria in gasous phases. The equilibrium constant. K_c and K_p. Factors influencing the chemical equilibrium. Homogeneous and heterogeneous equilibria.

Electrolytic solutions – Electrolytes. Dissociation degree. Colligative properties of electrolytic solutions. Van't Hoff. Acids and bases; Arrenius, Bronsted e Lowry, and Lewis theory. Acids and bases. Law of Oswald. pH. Hydrolysis. Buffer solutions. Polyprotic acids. acid-base titrations.

Heterogeneous systems - Saturated solutions. Solubility constant and common ion effect.

Chemical kinetics - Activated complex theory; activation energy. Kinetic equations and reaction order. Arrhenius equation. Catalyzers. Kinetic-to-equilibrium costants relationship.

Redox reactions and electrochemical potentials - Oxidation number. Redox reactions and their balancement. Reduction potentials. Nernst equation. Electromotive force of a cell. Half-cells. Chemical and concentration cells.

Organic chemistry

Hybridization of the carbon atom - sp^3, sp^2, sp hybridization and relative geometry.

Hydrocarbons – Saturated hydrocarbons: alkanes and cycloalkanes. Nomenclature. Conformational isomerism; geometric (cis-trans) isomerism. Reactions of alkanes. Alogenation mechanism. Unsaturated hydrocarbons: alkenes and alkines. Nomenclature. Addition reactions of alkenes. Markvonikov rule. Addition reactions of alkines.

Aromatic compounds – Structure of benzene: the model of resonance. Nomenclature of aromatic compounds. Mechanism of the aromatic electrophilic substitution. Aromatic ring's activating and deactivating substituents. *ortho*-, *para*-orienting groups and *meta*-orienting groups. Polycyclic aromatic hydrocarbons.

Alcohols, phenols, thiols - Nomenclature. Acidity and basicity of alcohols and phenols. Reactions of alcohols. Polyhydroxyl alcohols. Comparing alcohols and phenols. Aromatic substitution in phenols. Thiols.

Ethers - Nomenclature. Preparation of ethers. Resolution of ethers. Thioethers.

Aldehydes and ketones - Nomenclature. Preparation of aldheydes and ketones. The carbonyl group. Nucleophilic addition to carbonyl groups. Oxidation of carbonyl groups. Keto-enol tautomerism. Acidity of alpha-hydrogens. Alcohol condensation.
Carboxylic acids and their derivatives - Nomenclaturea. Carboxylate ion resonance. Structure's effect on acidity: the inductive effect. Preparation of acids. Carboxylic acids derivatives: esters, acyl halides, anhydrides, amides.

Bifunctional acids, oils and lipids – Bifunctional acids, unsaturated acids, keto-acids. Oils and lipids. Triesters of glycerol; mechanism of esterification. Phospholipids e steroids.
Amines and other nitrogen-containing compounds - Classification of amines and nomenclature. Basicity of amines. Amines *vs* amides. Reactions of amines. Etherocyclic compounds: pyrrole, pyridine, imidazole, pyrimidine, purine.

Stereoisomers - Chirality. Enantiomers. Polarized light. The polarimeter. Diastereoisomers. *Meso* compounds. Racemic mixtures.

Carbohydrates - Definition and classification. Monosaccharides. Chirality of monosaccharides; Fischer projection. Cyclic structure of monosaccharides. Anomeric effect. Mutarotation. Pyranose and furanose structures. Oxidation and reduction of monosaccharides. Disaccharides and polysaccharides.

Amino acids - Structure and properties of amino acids. pI. Reactions of amino acids. Peptides.

Nucleotides - Structure of nucleotides.

Recommended textbooks:
Giardina, Binaglia, *Chimica e propedeutica Biochimica*, Mc Graw Hill
Silvestroni, *Chimica generale*, Masson.
Hart et al., *Chimica organica*, Zanichelli.
Santaniello, Alberghina, Coletta, Marini, *Princìpi di chimica generale e organica*, Piccin
Silvestroni, Rallo, *Problemi di Chimica Generale*, Masson.
Lausarot, Vaglio, *Stechiometria per la Chimica generale*, Piccin