Course Outcomes : Chemistry

Place of teaching the Course	**Katwa College**
Department	**Chemistry**
Name of the Course	**CC-1A (Theo)**
Semester	**1st**
Course Title	**Atomic Structure, Chemical Periodicity, Acids And Bases, Redox Reactions, General Organic Chemistry & Aliphatic Hydrocarbons**
Main Topics of the Course	**1. Atomic Structure** **2. Chemical Periodicity** **3. Acids and bases** **4. Redox reactions** **5. Fundamentals of organic chemistry** **6. Stereochemistry** **7. Nucleophilic Substitution and Elimination Reactions** **8. Aliphatic Hydrocarbons** **9. Synthesis and reactions of alkanes** **10. Synthesis and reactions of alkenes** **11. Synthesis and reactions of alkynes**
Mentors	**Dr. Kedar Nath Mitra, Dr. Goutam Nandi, Dr. Dinesh Maity, Dr. Saptarshi Biswas, Prof. Siddhartha Maji**

Physical Chemistry

Atomic Structure:

Upon completion of these topics, students should be able to

- **CO 1** Learn Bohr's theory for hydrogen atom and atomic spectra of hydrogen.
- **CO 2** Idea about Bohr's model and Sommerfeld's model.
- **CO 3** Illustrate Pauli's exclusion principle, Hund's rule and Aufbau principle.
- **CO 4** Describe atomic spectra of hydrogen.

Chemical Periodicity:

Upon completion of these topics, students should be able to

- **CO 1** Differentiate general characteristics of s-, p-, d- and f-block elements.
- **CO 2** Predict periodic and group-wise variation of atomic and ionic radii, ionization potential, electron affinity, and electronegativity.
- **CO 3** know the positions of hydrogen and noble gases.

Acids and Bases and Redox Reactions:

Upon completion of these topics, students should be able to

- **CO 1** Differentiate the following concepts Brönsted–Lowry concept, Lewis acid-base concept, classification of Lewis acids and bases, Lux-Flood concept and solvent system concept.
- **CO 2** Describe conjugate acids and bases and relative strengths of acids and bases.
- **CO 3** Elucidate HSAB concept and its applications.
- **CO 4** Get idea of balancing of equations by oxidation number and ion-electron method.
- **CO 5** Predict oxidimetry and reductimetry processes.

Organic Chemistry

Upon completion of these topics, students should be able to

- **CO 1** Learn inductive effect, resonance and hyperconjugation.
- **CO 2** Differentiate between homolytic and heterolytic cleavage of bonds.
- **CO 3** Predict the structure of organic molecules on the basis of VBT.
- **CO 4** Draw orbital diagram of different types of bonding in organic compounds.
- **CO 5** Identify nucleophiles, electrophiles, nucleofuges and electrofuges.
- **CO 6** Get idea about reactive intermediates *e.g.* carbocations, carbanions and free radicals.
- **CO 7** Represent the molecule in different projection formulae (e.g. Fischer and Newman).
- **CO 8** Illustrate the asymmetric and dissymmetric molecules; enantiomers and diastereomer.
- **CO 9** Describe absolute and relative configuration: D/L, R/S and E/Z nomenclature.
- **CO 10** Learn elementary mechanistic aspects of nucleophilic substitution reactions (S_N1 & S_N2) and elimination reactions (E1 & E2).

- **CO 11** Predict Saytzeff and Hofmann elimination products
- **CO 12** Recognize substitution-elimination dichotomy in case of base catalyzed reactions.
- **CO 13** Get idea about different types of aliphatic hydrocarbons.
- **CO 14** Prepare alkanes using catalytic hydrogenation, Wurtz reaction, Kolbe's electrolysis, Grignard reagent and organocopper reagents.
- **CO 15** Functionalize alkanes and carry out substitution reactions of alkanes *via* free radical mechanism such as halogenations reactions.
- **CO 16** Synthesize alkenes *via* elimination reactions *e.g.* dehydration of alcohols, dehydrohalogenation of alkyl halides, partial catalytic hydrogenation of alkynes and Birch reduction of alkynes.
- **CO 17** Prepare diol on reaction with Baeyer's reagent, OsO_4 with alkenes.
- **CO 18** Prepare vicinal dibromides, halohydrins, epoxides with reasonable mechanisms.
- **CO 19** Add unsymmetrical addendum of HX type according to Markownikoff's and anti-Markownikoff's addition with unsymmetrical alkenes.
- **CO 20** Carry out hydration, ozonolysis, oxymercuration-demercuration and hydroboration-oxidation reactions on alkenes.
- **CO 21** Synthesize alkynes from metal carbides, by dehalogenation of tetra halides and dehydrohalogenation of vicinal & geminal dihalides.
- **CO 22** Convert terminal alkynes into non-terminal alkynes and vice-versa.
- **CO 23** Carry out addition, ozonolysis and oxidation reactions of alkynes.
- **CO 24** Exploit the acidity of acetylenic protons to form various metal acetylides.

Place of the Course	**Katwa College**
Department	**Chemistry**
Name of the Course	**CC-1B (Theo)**
Semester	**2nd**
Course Title	**States of Matter & Chemical Kinetics, Chemical Bonding & Molecular Structure, P-Block Elements**
Main Topics of the Course	1. Kinetic Theory of Gases and Real gases 2. Liquids 3. Solids 4. Chemical Kinetics 5. Chemical Bonding and Molecular Structure 6. Comparative study of p-block elements
Mentors	**Dr. Goutam Nandi, Dr. Dinesh Maity, Dr. Saptarshi Biswas, Prof. Siddhartha Maji**

Physical Chemistry

Kinetic Theory of Gases and Real gases

On completion of the course, students are able to:

CO 1 Explain the concept of pressure and temperature from Kinetic Theory of gases.
CO 2 State the postulates of kinetic theory of gas.
CO 3 derive the equations of states for an ideal gas and a real gas.
CO 4 Describe physical basis for the kinetic theory of gases.
CO 5 Represent the laws from kinetic theory of gases.
CO 6 State the assumptions for Maxwell's law of distribution of molecular speed.
CO 7 Explain the relationship between partial pressures and the total pressure as described in Dalton's law of Partial Pressure.

Liquids

On completion of the course, students are able to:

CO 1 Explain surface tension and its determination through stalagmometer.
CO 2 Describe viscosity and principle of determination of coefficient of viscosity using Ostwald viscometer.
CO 3 Illutrate the effect of temperature on surface tension and coefficient of viscosity of a liquid.

Solids

On completion of the course, students are able to:

CO 1 Be familiar with different forms of solids, crystal systems, unit cells, Bravais lattice types, Symmetry elements.
CO 2 Know two laws of crystallography - Law of constancy of interfacial angles, Law of rational indices.

CO 3 Assign Weiss and Miller indices of different planes and interplanar distance.
CO 4 Formulate Bragg's law.
CO 5 Describe the structures of NaCl, KCl and CsCl qualitative.
CO 6 Describe various types of defects in crystals.
CO 7 Define Glasses and liquid crystals.

Chemical Kinetics

On completion of the course, students are able to:

CO 1 Discuss the factors that affect the rate of chemical reactions.

CO 2 Differentiate between order and molecularity of a chemical reaction.

CO 3 Describe the general form of a (differential) rate law and how the rate of a chemical reaction depends on the concentrations of species that appear in the rate law.

CO 4 Determine the "overall reaction order" for a chemical reaction using the (differential) rate law.

CO 5 Derive a general expression for the unit of rate constant and to find the unit of rate constant for zero, 1st, 2nd and 3rd order reaction.

CO 6 State the basis for the "Collision Model" and "Transition State Model" of Chemical Kinetics.

CO 7 Explain why reactant molecules must have a certain minimum amount of kinetic energy when they collide in order for a chemical reaction to occur.

CO 8 Describe "activation energy" and how it can be experimentally determined.

Inorganic Chemistry

Chemical Bonding and Molecular Structure

On completion of the course, students are able to:

CO 1 Know the general characteristics of different kinds of bonding.
CO 2 Energy considerations in ionic bonding, lattice energy and solvation energy.
CO 3 Establish the Born-Landé equation for calculation of latticeenergy, Born-Haber cycle and its applications.
CO 4 Describe polarizing power and polarizability.
CO 5 Illustrate Fajan's rules, ionic character in covalent compounds, dipole moment and percentage ionic character.
CO 6 Elucidate VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR
CO 7 Define hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.
CO 8 Know the general concept of resonance and resonating structures in various inorganic and organic compounds.

CO 9 Illustrate MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals
CO 10 Describe MO treatment of homonuclear diatomic molecules of 1st and 2nd periods.
CO 11 Describe MO treatment of heteronuclear diatomic molecules such as CO, NO and NO^+.
CO 12 Differentiate VB and MO approaches.

Comparative study of p-block elements

On completion of the course, students are able to:

CO 1 Explain Group trends in electronic configuration, modification of pure elements, common oxidation states, inert pair effect.
CO 2 Elucidate Group 13 to 17 and their important compounds.

Course Outcomes : Chemistry

Place of teaching the Course	**Katwa College**
Department	**Chemistry**
Name of the Course	**CC-1C (Theo)**
Semester	**3rd**
Course Title	**Chemical energetic, equilibria, organic chemistry**
Main Topics of the Course	**1. Chemical Energetics** **2. Chemical Equilibrium** **3. Ionic Equilibria** **4. Aromatic Hydrocarbons** **5. Aryl Halides** **6. Organometallic Compounds** **7. Alcohols, Phenols and Ethers** **8. Carbonyl Compounds**
Mentors	**Dr. Kedar Nath Mitra, Dr. Goutam Nandi, Dr. Dinesh Maity, Dr. Saptarshi Biswas, Prof. Siddhartha Maji**

Physical Chemistry

Ionic Equilibria:

Upon completion of these topics, students should be able to

- **CO 1** Describe types of electrolyte and degree of ionization.
- **CO 2** Represent ionization of weak acids and bases, degree of hydrolysis and hydrolysis constant.
- **CO 3** Explain p^H and Buffer solution.
- **CO 4** Elucidate solubility product of sparingly soluble salts and applications of solubility product.

Organic Chemistry

Upon completion of these topics, students should be able to

- **CO 1** Prepare benzene from phenol, benzenesulfonic acid, acetylene, iodoform, benzoic acid, aniline and nitrobenzene.

- **CO 2** Learn general mechanistic aspects of electrophilic aromatic substitution reactions *e.g.* nitration, halogenations, sulfonation, Friedel-Craft's alkylation & acylation.

- **CO 3** Predict the products of side chain oxidation of various types of alkyl benzenes.

- **CO 4** Synthesize halobenzenes from phenol and *via* Sandmeyer reactions.

- **CO 5** Understand the effect of NO_2 groups on nucleophilic aromatic substitution reactions of halobenzenes (activated nucleophilic substitution).

- **CO 6** Understand the use of Zn instead of Mg in Reformatsky reaction.

- **CO 7** Prepare alcohols using Grignard reagent, reduction of aldehydes, ketones, carboxylic acid, carboxylic esters and hydration of alkenes.

- **CO 8** Differentiate 1°, 2° and 3°- alcohols employing Lucas test.

- **CO 9** Carry out alkaline $KMnO_4$/acidic dichromate/concentrated HNO_3 mediated oxidation reactions of alcohols.

- **CO 10** Correlate Oppenauer oxidation with MPV reduction.

- **CO 11** Prepare 1, 2-diols on reaction with OsO_4 and Baeyer's reagent

- **CO 12** Explain mechanistically the involvement of 1, 2-diols in pinacol-pinacolone rearrangement.

- **CO 13** Prepare phenols using cumene-hydroperoxide method and from diazonium salts.

- **CO 14** Compare the acidity of phenols and carboxylic acids.

- **CO 15** Carry out the electrophilic aromatic substitution reactions on phenols *e.g.* nitration, halogenations, Reimer-Tiemann, Houben–Hoesch reaction.

- **CO 16** Perform esterification reaction employing Schotten-Baumann reaction condition.

- **CO 17** Prepare adrenaline and noradrenaline with the help of Fries rearrangement.

- **CO 18** Know the mechanistic pathway of Claisen rearrangement.

- **CO 19** Prepare ethers using Williamson's ether synthesis technique.

- **CO 20** Cleavage ethers with HI.

- **CO 21** Synthesize carbonyl compounds from acid chlorides, nitriles and Grignard reagents.

- **CO 22** Mechanistically know the reactions of carbonyl functionality with HCN, H_2O, ROH, $NaHSO_3$, Hydrazine, Hydroxylamine, semicarbazide and 2, 4-DNP.

- **CO 23** Differentiate between aldehydes and ketones using iodoform, Tollens' and Fehling's tests.

- **CO 24** Predict the types of compounds responsive to haloform test.

- **CO 25** Elaborate condensation reactions of aldehydes and ketones *e.g.* aldol condensation and benzoin condensation.

- **CO 26** Convert carbonyls into alkenes *via* Wittig reaction.

- **CO 27** Reduce carbonyls *via* Clemmensen reduction, Wolff- Kishner reduction and Meerwein-Pondorff-Verley (MPV) reduction.