COURSE WISE & SUBJECT WISE OUTCOME

OF UG HONOURS COURSE (B.A/B.Sc.) IN CHEMISTRY

UNDER CHOICE BASED CREDIT SYSTEM

INTRODUCED BY UNIVERSITY OF CALCUTTA, 2018

DEPARTMENT OF CHEMISTRY

SEMESTER-1

Paper: CEMA-CC-1-1
(Credits: Theory-04, Practicals-02)
Inorganic Chemistry-1

Topics		Outcome
Extra nuclear Structure of atom: Acid-Base reactions: Redox Reactions:		• Develop the clear concept of atomic structure Different atomic models, their merits and de merits, idea of different quantum no.s, • Learn about the GS term symbols • Knowledge of electronic configurations • Ideas of different acid base concepts with examples • Develop the practical knowledge of acid base interactions • Interpretation of plots of acid base titrations • Knowledge of choose of different indicators • Concepts generates on oxidation – reduction reactions • Extend the awareness of influence of external factors on Std. E° value • Comprehend the various aspects ion electron balance process. • These knowledge are highly helpful for boost up the basic concepts of inorganic reactions • Helpful for advance studies like M.Sc.
Practical: Acid and Base Titrations: Oxidation-Reduction Titrations: [Fe, Cu, Cr, Mn]		• Develop the skills on manual titrations • Acquire knowledge of separation and estimation of metal ions in a mixture • Really helpful for industrial requirements as well as advance study

Paper: CEMA-CC-1-1A AND 1B
(Credits: Theory-04, Practicals-02)
Organic Chemistry

Topics		Outcome
Bonding and Physical Properties		• Develop the clear concept of Hybridisation.

General Treatment of Reaction Mechanism:-I General Treatment of Reaction Mechanism:-II Stereochemistry:- I		• How hybridisation affects the different bond properties. • Knowledge of effects of different Electronic displacements. • Develop the concept of M.O theory. • To develop concept of aromaticity based on M.O. theory. • Knowledge of Frost Diagram. • Idea of Homoaromaticity and Antiaromaticity. • Idea of different type of reactions. • Develop the different type of bond cleavage. • Concept of reaction intermediates. • Concept of symmetry in a molecule. • Idea of different projection formulae • Concept of Stereogenicity,Chirotopicity • Idea of configurational nomenclature
Practical: Separation of two organic substances based on solubility Determination of boiling point		• Develop the idea of selection of solvent for separation. • Develop the skills of separation manually . • Learning of determination of boiling pointof a liquid.

Paper: CEMA-CC-1-2-TH

(Credits: Theory-04, Practicals-02)

Physical Chemistry-1 Theory (40 Lectures)

Topic: Kinetic Theory and Gaseous state and Chemical kinetics.

Objective of the Course	Expected Learner Outcome
1.To develop a strong knowledge on Kinetic Theory of gases and its transport properties 2. knowledge on Chemical kinetics	1. Students will gain an understanding of Concept of pressure and temperature; Kinetic molecular model of a gas behaviour of real gases compressibility factor; Boyle temperature Wall collision and rate of effusion Maxwell's distribution of speed and energy Intermolecular forces like Debye, Keesom and interactions; Lennard-Jones potential transport properties in gases. General features of fluid flow (streamline flow and turbulent flow); Newton's equation, viscosity coefficient; Poiseuille's equation. Temperature variation of viscosity of liquids and comparison with that of gases. Relation between viscosity coefficient of a gas and mean free path. 2. concepts on Rate law, order and molecularity. Extent of reaction; rate constants, order; Forms of rates of First, second and nth order reactions;

CEMA-CC-1-2-P: 1: Study of kinetics of decomposition of H2O2 2: Study of kinetics of acid-catalyzed hydrolysis of methyl acetate 3: Study of viscosity of unknown liquid (glycerol, sugar) with respect to water. 4: Study of the variation of viscosity with the concentration of the solution 5: Determination of solubility of sparingly soluble salt in water, in electrolyte with common ions and in neutral electrolyte (using common indicator)	Determination of order of a reaction by half-life and differential method; Rate determining step and steady-state approximation. Temperature dependence of rate constant; Arrhenius equation, energy of activation; Homogeneous catalysis with reference to acid-base catalysis; Enzyme catalysis; Michaelis-Menten equation, Lineweaver-Burk plot, turn-over number. Develop the skill of application of theory in practical experiments. Hands on experience on different experimental techniques like titration, data collection and interpretation. Students will acquire the knowledge of handling different modern sophisticated instruments.

SEMESTER-2

Paper: CEMA-CC-2-3
(Credits: Theory-04, Practicals-02)
Organic Chemistry

Topics		Outcome
General Treatment of Reaction Mechanism:-I II Stereochemistry:- I I Substitution and Elimination Reaction		• Develop the idea of reaction kinetics and reaction thermodynamics. • Knowledge of potential energy diagram of one step, two steps and three steps reactions. • Idea of K.C.P and T.C.P reactions. • Idea of Hammond's postulates. • Knowledge of acid-base. • Develop the idea of different types of tautomerism. • Idea of Nucleophilic and Free radical substitution reactions. • Knowledge of Elimination reactions. • Concept of Chiral axis, Chiral Planes,Pro-chiral centres • Idea of Topicity of ligands and faces. • Knowledge of different Conformations • Develop the idea of relative stabilities of different Conformers.

Practical: Organic Preparation using different type of reactions:-		• Develop a practical idea to carry out the different organic reactions using air condenser, reflux condenser etc. • Idea of carrying out the reactions using green procedure. • Idea of carrying out the reactions in solid phase. • Knowledge of purification of a solid by crystallisation

Paper: CEMA-CC-2-4
(Credits: Theory-04, Practicals-02)
Inorganic Chemistry-2

Topics		Outcome
Chemical Bonding-I: Chemical Bonding-II: Radioactivity:		• Comprehend the various aspects of different types of bonding between atoms • Develop the clear concept of electrostatic interaction and electron sharing interaction, • Learn about the VBT and VSEPR • Knowledge of MOT • Ideas of shapes and hybridizations of different molecules • Develop the practical knowledge of weak force and non bonding interactions • Interpretation of stability, reactivity, magnetism of molecules using MO diagram • Knowledge of the incidents inside the nucleus • Concepts generates on decay of unstable nucleus • Comprehend the various aspects of stability/instability of nucleus • Extend the awareness of different nuclear models • These knowledge are highly helpful for enhance the basic perception of molecular bonding and radioactivity which are supportive for advance studies like M.Sc. or research
Practical: Iodo-/ Iodimetric Titrations: Estimation of metal content in some selective samples: [Brass, Steel, Vit-C, Bleaching Powder, Cement, As, Sb]		• Develop the titrations skills and instrument handling • Acquire knowledge of separation and estimation of ores and metal ions in a mixture • These proficiency helpful for industrial requirements as well as advance study

SEMESTER-3

Paper: CEMA-CC-3-5-TH

(Credits: Theory-04, Practicals-02)

Chemical Thermodynamics I. Chemical Thermodynamics II. Applications of Thermodynamics – I. electrochemistry.

Objective of the Course	Expected Learner Outcome
1.To develop a strong knowledge on chemical thermodynamics, their mathematical expression & application. 2. To develop the basic knowledge on electrochemistry, various laws governing electro chemical process and their application. **CEMA-CC-3-5-P:** 1: Conductometric titration of an acid (strong, weak/ monobasic, dibasic, and acid mixture) against strong base. 2: Study of saponification reaction conductometrically 3: Verification of Ostwald's dilution law and determination of Ka of weak acid Experiment	Students will gain an understanding of Concept Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics; Concept of heat, work, internal energy and statement of first law; enthalpy, H; etc. They will gain knowledge on Systems of Variable Composition: Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures. They will have strong ideas on applications of Thermodynamics :Chemical Equilibrium: Thermodynamic conditions for equilibrium, degree of advancement; van't Hoff's reaction isotherm. 2. will have concepts on Conductance and transport number Ion conductance; Conductance and measurement of conductance, cell constant, specific conductance and molar conductance; Variation of specific and equivalent conductance with dilution for strong and weak electrolytes; Kohlrausch's law of independent migration of ions; Equivalent and molar conductance at infinite dilution and their determination for strong and weak electrolytes; Debye –Huckel theory of Ion atmosphere. Students will acquire the knowledge of application of theory to practical experiments. Different types of conductometric experiments. Potentiometric studies of different redox systems etc.

4:Potentiometric titration of Mohr's salt solution against standard K2Cr2O7 and KMnO4solution 5: Determination of Ksp for AgCl by potentiometric titration of AgNO3 solution against standard KCl solution Experiment 6: Determination of heat of neutralization of a strong acid by a strong base	

Paper: CEMA-CC-3-6
(Credits: Theory-04, Practicals-02)
Inorganic Chemistry-3

Topics		Outcome
Chemical periodicity: Chemistry of *s* and *p* Block Elements: Noble Gases: Inorganic Polymers: Coordination Chemistry-I:		• Develop the clear concept of periodic table, • Ideas of periodic properties of elements • Learn about the anomalous behavior • Comparisons of the properties of s and p block elements • Develop the practical knowledge noble gases and their unstable compounds • Idea of inorganic synthetic polymers • Concepts generates coordination and coordination compounds • Interpretation of their stability, reactivity, bonding • Knowledge of the IUPAC nomenclature • These information are very supportive for enhance the fundamental view of coordinate bonding and coordination chemistry which are supportive for advance studies like M.Sc. B.Tech or Research and developments
Practical: Complexometric titration: [Ca, Mg, Al, Fe, Cu] Chromatography of metal ions: [Fe, Al, Co, Ni] Gravimetry: [Al, Cu, Ni]		• Enhanced the titrations skills and instrument handling • Acquire knowledge of separation and estimation of metal ions in a mixture • Experienced the basic knowledge of chromatography and gravimetry • These aptitude are very helpful for industrial requirements as well as advance study and Ph.D works

Paper: CEMA-CC-3-7
(Credits: Theory-04, Practicals-02)
Organic Chemistry

Topics		Outcome
Chemistry of Alkenes and Alkynes:- Aromatic Substitutions:- Carbonyl and Related Compounds:- Organometallics:-		• Knowledge of reactivity of alkenes towards different reagents • Idea of different addition reactions that alkenes can undergo • Concept of regioselectivity of addition reactions of alkenes • Knowledge of allylic and benzylic bromination of alkenes • Idea of addition of carbenes to alkenes • Concept of isomerization of alkenes • Idea of reactivity of alkynes towards addition reactions. • Concept of the mechanism of different aromatic electrophilic and nucleophilic substitution reactions • Concept of ease of aromatic electrophilic substitution compared to nucleophilic ones • Idea of the structure of benzyne intermediate • Knowledge of different nucleophilic addition reactions of carbonyl compounds • Idea of oxidation and reduction of carbonyl compounds • Different condensation reactions of carbonyls through the formation of α carbanions • Idea of nucleophilic addition to α, β - unsaturated carbonyl compounds • Concept of reactions involving substitution at sp2 carbon • Idea of behaviours of Grignard reagent,organolithium and Gilman cuprates
Practical: Identification of a pure Organic Compound:- Quantitative Estimation:-		• Enhanced the titrations skills and instrument handling • Acquire knowledge of estimation of a particular component in a compound. • These aptitude are very helpful for industrial requirements as well as advance study and Ph.D works

SKILL ENHANCEMENT COURSES SEC-A [SEMESTER 3]

SEC 1 – **Mathematics and Statistics for Chemists** (Credits: 2 Lectu**res: 30)**

Objective of the Course	Expected Learner Outcome
To develop the basic knowledge on Functions, Probability, Vectors, matrices and determinants, Qualitative and quantitative aspects of analysis and Analysis and Presentation of Data.	Students will gain an understanding of Concept of Functions, limits, derivative, physical significance, basic rules of differentiation, maxima and minima, applications in chemistry. They will acquire knowledge on Vectors, dot, cross and triple products, introduction to matrix algebra, addition and multiplication of matrices, inverse, adjoint and transpose of matrices, unit and diagonal matrices. They will understand Sampling, evaluation of analytical data, errors, accuracy and precision, methods of their expression, normal law of distribution if indeterminate errors, statistical test of data; F, Q and t test, rejection of data, and confidence intervals.

SEMESTER-4

CEMA-CC-4-8
(Credits: Theory-04, Practicals-02)
Organic Chemistry

Topics		Outcome
Nitrogen Compounds:- Rearrangements:- The Logic of Organic Synthesis:- Organic Spectroscopy:-		• Concept the different reactions of various nitrogenous compounds • Development of idea on different types of rearrangement reactions • Concept on retrosynthesis- i.e. how a synthesis can be designed from the structure of the final product of a synthesis. • Develop good concept on synthesis • Develop a idea about UV,IR and NMR spectroscopy which is a very essential tool for determination of the structure of an unknown compound • These are very much supportive for advance studies like M.Sc. B.Tech or Research and developments and Academic career also • Helpful for competitive exams like JAM, NET, GATE, SET, GRE

Practical: Qualitative Analysis of Single Organic Compounds:-		• Develop idea of special reaction of a particular element and functional group • Learning on the determination of melting point • Develop the skills of identifying an unknown compound by characteristics reactions,melting point and preparation of derivatives. • These aptitude are very helpful for Research works in future and industrial requirements as well as advance study

Paper: CEMA-CC-4-9-TH

(Credits: Theory-04, Practicals-02)

Application of Thermodynamics: Phase Equilibrium, Foundation of Quantum Mechanic , Crystal Structure.

Objective of the Course	Expected Learner Outcome
To develop a strong knowledge on different aspect of application of thermodynamics like phase Equilibrium, Colligative properties. They will understand the concept and origin of Quantum Mechanics. Strong ideas on Crystal Structure.	They will understand different Colligative properties like ((i) Vapour pressure of solution, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) Osmotic pressure etc. Raoult's law; Thermodynamic derivation using chemical potential to derive relations between the four colligative properties. They will have strong understanding on Phase Equilibrium: Definitions of phase, component and degrees of freedom; Phase rule and its derivations; Definition of phase diagram; Phase diagram for water, CO2, Sulphur. They will have strong understanding on Foundation of Quantum Mechanics, Students will gain an understanding of i. The difference between classical and quantum mechanics operators and its algebra. Schrodinger time-independent equation; nature of the equation, acceptability conditions for the wave functions and probability interpretations of wave function Vector representation of wave function. Orthonormality of wave function. They will acquire knowledge on Bravais Lattice and Laws of Crystallography: Types of solid, Bragg's law of diffraction etc. Will have knowledge on Crystal planes: Distance between consecutive planes [cubic, tetragonal and orthorhombic lattices]; Indexing of planes.

CEMA-CC-4-9-P: 1: Kinetic study of inversion of cane sugar using a Polarimeter 2: Study of Phase diagram of Phenol-Water system. 3: Determination of partition coefficient for the distribution of I2 between water and CCl4 4: Determination of pH of unknown solution (buffer), by colour matching method 5: pH-metric titration of acid (mono- and di-basic) against strong base 6 : pH-metric titration of a tribasic acid against strong base	Develop the concepts of application of theory in practical by doing hands on experiments. Students will acquire the knowledge of handling different modern sophisticated instruments like digital polarimeter, pH meter etc. These will help in their higher studies as well as give exposure to industry.

CEMA-CC-4-10
(Credits: Theory-04, Practicals-02)
Inorganic Chemistry-4

Topics		Outcome
Coordination Chemistry-II: Chemistry of d- and f- block elements: Transition Elements: Lanthanoids and Actinoids: Reaction Kinetics and Mechanism:		• Extend the idea of Coordination Chemistry, • Ideas developed on CFT • Acquire the idea of splitting of d orbitals • Develop the practical knowledge of electronic arrangements, structure, energy, deformations • Concepts generates on spectra and magnetic behavior of coordination compounds • Learn about the Orgel Diagram • Interpretation of the properties of d and f block elements • Knowledge of A, D, Ia and Id reaction mechanism • Learn about the trans effect • Develop the clear concept of labile and inert compounds • These are very supportive and interesting for improve the fundamental analysis of bonding and properties of inorganic molecules • which are supportive for advance studies like M.Sc. B.Tech or Research and developments and Academic career also • Helpful for competitive exams like JAM, NET, GATE, SET, GRE
Practical: Inorganic preparations: [Complex salts of Co, Ni, Cu, Mn, Cr, Fe] *Instrumental Techniques:*		• Develop the practical knowledge of synthesis of organic and inorganic transition metal complexes

[UV-vis, FTIR]		• Experienced the basic techniques of purification and isolation of complexes • Develop the skills regarding the handling of spectral instruments and how to run a sample using these instruments. • These aptitude are very helpful for Research works in future and industrial requirements as well as advance study

CEMA- SEC-B3

(Credits: Theory-04, Practicals-02)

Pharmaceuticals Chemistry

Topics		Outcome
Drugs & Pharmaceuticals **Fermentation**		• Knowledge regarding synthesis of different drugs and their functions against different diseases • Idea of production of ethyl alcohol and citric acid by fermentation • Idea about functions of antibiotics,penicillin,cephalosporin etc

CEMA- SEC-B4

(Credits: Theory-04, Practicals-02)

Pesticide Chemistry

Topics		Outcome
PESTICIDES		• Knowledge regarding synthesis of different pesticides and their functions

Paper: CEMA-CC-5-11-TH

(Credits: Theory-04, Practicals-02)

Quantum Chemistry II, Statistical Thermodynamic, Numerical Analysis

Objective of the Course	Expected Learner Outcome
To understand Simple Harmonic Oscillator, Angular momentum, Hydrogen atom and hydrogen-like ions, Statistical Thermodynamics , Numerical Analysis.	Students will gain an understanding of concept of Setting up of One-dimensional Schrödinger equation and discussion of solution and wave functions. Classical turning points, Expectation values of x, x2 , px and px 2 .

CEMA-CC-5-11-P: **Topic:** Computer programs (Using FORTRAN or C or C ++) based on numerical methods: Programming 1: Roots of equations: (e.g. volume of van der Waals gas and comparison with ideal gas, pH of a weak acid) Programming 2: Numerical differentiation (e.g., change in pressure for small change in volume of a van der Waals gas, Potentiometric titrations) Programming 3: Numerical integration (e.g. entropy/ enthalpy change from heat capacity data), probability distributions (gas kinetic theory) and mean values	Will learn to set up of Schrödinger equation in spherical polar coordinates, Separation of variables, Solution of angular Part (φ part only), quantization of energy. They will learn configuration: Macrostates, microstates and configuration; calculation with harmonic oscillator; variation of W with E; equilibrium configuration. Will understand Partition function: molecular partition function and thermodynamic properties. Understand Roots of Equation:Numerical methods for finding the roots of equations. Students will gain an understanding of a) Model of computer, BASIC, FORTAN, role of computers in chemistry b) writing simple programs in FORTAN language c) molecular modelling.

CEMA-CC-5-12
(Credits: Theory-04, Practicals-02)
Organic

Topics		Outcome
Carbocycles and Heterocycles: Cyclic Stereochemistry: Pericyclic Reactions:- Carbohydrates:- Biomolecules:-		• Develop the clear concept of polynuclear compounds and heterocycles • Concept of different reactions of cyclic systems, • Knowledge about the relative stabilities of cyclic compounds • Develop of concept regarding mechanism, stereochemistry, and regioselectivity of electro cyclic, cycloaddition, Diels-Alder and sigmatropic reactions. • Idea of carbohydrates • Knowledge regarding amino acids, proteins, peptides, DNA,RNA etc
Practical: 1. **Chromatographic Separations:-**		• Development of idea of chromatography. • Skills of separation of a mixture by column and thin layer chromatography

2. **Spectroscopic Analysis of Organic Compounds:-**		• Identification of an unknown compound utilising spectroscopic techniques • These aptitude are very helpful for industry and research

CEMA-DSE-B 1
(Credits: Theory-04, Practicals-02)
Inorganic Materials of Industrial Importance

Topics		Outcome
Silicate Industries: Fertilizers: Surface Coatings: Batteries: Alloys: Catalysis: Chemical explosives:		• Develop the clear concept of ceramics and glass manufacturing • Extend the idea of composition of variety of Glass, • Learn about the N and P fertilizers • Comparisons of the different explosives • Acquire the idea of composition of alloys and their preparation • Develop the practical knowledge of structure, energy, deformation • Concepts generates on spectra and magnetic behavior of coordination compounds • Interpretation of the properties surface coating • Knowledge of explosion reaction mechanism • Develop the clear concept of Homogeneous and heterogeneous catalysis • Learn about the catalytic use in industry • Concepts generates on different Batteries • These ideas are absolutely new and effective and interesting • Improve the innovative ideas on applications and industrial knowledge • encouraging for advance technical studies like B.Tech (Chemical, ceramics, polymers, oil, pharmaceuticals) or Research and developments
Practical: 1. Determination of free acidity in ammonium sulphate fertilizer. 2. Estimation of Calcium in Calcium ammonium nitrate fertilizer. 3. Estimation of phosphoric acid in superphosphate fertilizer. 4. Electroless metallic coatings on ceramic and plastic material. 5.Determination of composition of dolomite (by complexometric titration).		• Develop the practical knowledge of estimation of different components of fertilizer. • Experienced the basic techniques of metallic coating on plastic materials • Acquire knowledge of separation and estimation of ores and Alloys • These aptitude are very helpful for industrial requirements in different fertilizer and ceramic industries

6.Analysis of (Cu, Ni); (Cu, Zn) in alloy or synthetic samples. 7.Analysis of Cement		

CEMA-DSE-B 2
(Credits: Theory-04, Practicals-02)
Novel Inorganic Solids

Topics		Outcome
Synthesis and modification of inorganic solids: Inorganic solids of technological importance: Nanomaterials: Introduction to engineering materials for mechanical construction: Composite materials: Speciality polymers:		• Develop the clear concept of inorganic solids • Learn about the procedure of synthesis of solids • Acquire the idea of important topic nano particles • Develop the clear concept of synthesis of nono materials and its properties • Extend the idea of engineering materials • Comparisons of the different explosives • Develop the practical knowledge of structure, energy, deformation • Concepts generates on spectra and magnetic behavior of inorganic materials • Interpretation of the properties of polymers • Learn about the catalytic use in industry • Concepts generates on composite materials • These ideas are absolutely new, effective, interesting and demanding • Improve the innovative ideas on applications and industrial knowledge • encouraging for advance technical studies like B.Tech (Chemical, ceramics, polymers, oil, pharmaceuticals) or Research and developments related to nano materials, nanotechnology like nono drug, nano biomaterials, nano sensors , nano markers.
Practical: 1. Determination of cation exchange method 2. Determination of total difference of solids. 3. Synthesis of hydrogel by co-precipitation method. 4. Synthesis of silver and gold metal nanoparticle		• Develop the practical knowledge of ion exchange resin • Experienced the basic techniques of synthesis of gold nano particles • Acquire knowledge of synthesis of Gel materials • These aptitude are very helpful for industrial requirements dealing with nanotechnology like nono drug, nano biomaterials, nano sensors , nano markers.

Paper: DSE-A-2

Applications of Computers in Chemistry

(Credits: Theory-04, Practicals-02)

Objective of the Course	Expected Learner Outcome
i. To learn Computer Programming Basics (FORTRAN), ii. Introduction to Spreadsheet Software(MS Excel), iii.Statistical Analysis.	i. Students will gain an understanding of Elements of FORTRAN Language.FORTRAN Keywords and commands, Logical and Relational Operators, iteration, Array variables, Matrix addition and multiplication.Function and Subroutine. ii. Creating a Spreadsheet, entering and formatting information. Solution of simultaneous equations(for eg: in chemical Equilibrium problems) using Excel SOLVER Functions. Use of Excel Goal Seek function. Numerical Modelling: Simulation of pH metric titration curves, Excel functions LINEST and Least Squares. Numerical Curve Fitting, Regression, Numerical Differentiation and Integration. iii. Gaussian Distribution and Errors in Measurement and their effect on data sets. Descriptive Statistics using Excel, Statistical Significance Testing, the T test and the F test.
PRACTICALS DSE-A-2: APPLICATIONS OF COMPUTERS IN CHEMISTRY: 1. Plotting of Graphs using a spreadsheet. Planck's Distribution Law, Maxwell Boltzmann Distribution Curves as a function of temperature and molecular weight) 2. Determination of vapour pressure from Van der Waals Equation of State. 3. Determination of rate constant from Concentration-time data using LINEST function. 4. Determination of Molar Extinction Coefficient from Absorbent's data using LINEST function. 5. Determination of concentration simultaneously using Excel SOLVER Function.(For eg: Determination of [OH-], [Mg2+] and [H3O+] from Ksp and Kw data of Mg(OH)2.) 6. Simultaneous Solution of Chemical Equilibrium Problems to determine the equilibrium compositions from the Equilibrium Constant data at a given Pressure and Temperature.	To demonstrate an advanced understanding of computational chemistry. Students will gain an understanding of a) Model of computer, FORTAN, role of computers in chemistry b) writing simple programs in BASIC language c) molecular modelling.

7. Determination of Molar Enthalpy of Vaporization using Linear and Non Linear Least squares fit. 8. Calculation and Plotting of a Precipitation Titration Curve with MS Excel. 9. Acid-Base Titration Curve using Excel Goal Seek Function. 10. Plotting of First and Second Derivative Curve for pH metric and Potentiometric titrations . 11. Use of spreadsheet to solve the 1D Schrodinger Equation (Numerov Method). 12. Michaelis-Menten Kinetics for Enzyme Catalysis using Linear and Non - Linear Regression.	

SEMESTER-6

CEMA-CC-6-13
(Credits: Theory-04, Practicals-02)
Inorganic Chemistry-5

Topics		Outcome
Theoretical Principles in Qualitative Analysis, Bioinorganic Chemistry: Organometallic Chemistry: Catalysis by Organometallic Compounds:		• Acquire the theoretical knowledge of chemical test of cations and anions • Extend the idea separation of ions and their detections, • Ideas developed on elements in life their importance • Develop the practical knowledge of synthesis of Metal containing drugs • Concepts generates on bioactivity of different enzyme and proteins • Learn about the organometallics compounds • Interpretation of the synthesis properties and reactions of organometallics compounds • Knowledge of mechanism of different catalytic cycles • Learn about the catalysts use in industry • Develop the clear concept of metallocenes • These are very supportive and interesting for improve the fundamental analysis of inorganic salts and their mixture • which are supportive for advance studies like M.Sc. B.Tech or Research and developments and Academic career • Also helpful for competitive exams like JAM, NET, GATE, SET, GRE
Practical:		• Develop the practical knowledge of detection of different inorganic ions

Qualitative semi micro analysis of mixtures containing not more than three radicals. Emphasis should be given to the understanding of the chemistry of different reactions: **[All inorganic salts]**		• Experienced the basic techniques of micro and semi micro analysis • Acquire knowledge of composition and estimation of ores and alloys • These aptitudes are very helpful for industrial requirements dealing with inorganic compounds, colour and paints, glass, silicates, metallurgy, fuel, catalysts, chemicals.

Paper: CEMA-CC-6-14-TH

(Credits: Theory-04, Practicals-02)

Molecular Spectroscopy, Photochemistry and Theory of reaction rate, Surface phenomenon, Dipole moment and polarizability

Objective of the Course	Expected Learner Outcome
i.To understand Rotation spectroscopy, Vibrational spectroscopy, Electronic Spectroscopy, Raman spectroscopy. ii.Different aspect of photochemistry iii.Surface tension and energy, Adsorption, Colloids, iv.Deeper understanding of Dipole moment and polarizability.	i.Students will gain an understanding of different aspect of molecular spectroscopy. This will help for their study at master and higher level. ii.to understand Lambert-Beer's law: Characteristics of electromagnetic radiation, Rate of Photochemical processes: Photochemical equilibrium and the differential rate of photochemical reactions, Photo stationary state. Iii.physical significance of absorption coefficients; Surface tension, surface energy, excess pressure. Lyophobic and lyophilic sols, Origin of charge and stability of lyophobic colloids, Coagulation and Schultz-Hardy rule, Zeta potential and Stern double layer. iv. to know polarizability of atoms and molecules, dielectric constant and polarisation, molar polarisation for polar and non-polar molecules; Clausius-Mosotti equation and Debye equation.

CEMA-CC-6-14-P

Objective of the Course	Expected Learner Outcome
1: Determination of surface tension of a liquid using Stalagmometer 2: Determination of the indicator constant of an acid base indicator spectrophotometrically 3: Verification of Beer and Lambert's Law for $KMnO_4$ and $K_2Cr_2O_7$ solution 4: Study of kinetics of $K_2S_2O_8$ + KI reaction, spectrophotometrically	Students will gain an understanding and exposure to different modern sophisticated digital instruments. This will help them deeper understanding of the theory and hand on activity. It will enhance their opportunity at higher level of study.

5: Determination of pH of unknown buffer, spectrophotometrically 6: Determination of CMC of a micelle from Surface Tension Measurement	

CEMA-DSE-A 3
(Credits: Theory-04, Practicals-02)
Green Chemistry and Chemistry of Natural Products

Topics		Outcome
Introduction to Green Chemistry: Principles of Green Chemistry and Designing a Chemical synthesis: Examples of Green Synthesis/ Reactions and some real world cases: **Future Trends in Green Chemistry:** Alkaloids: Terpenes :		• Concept of green chemistry • Idea about 12 principles of green chemistry • Acquire the idea of important topic nanoparticles • Idea about alternative source of energy • Concept of green solvent • Knowledge about different reactions in green manner • Idea about MW, US reactions • Idea about green counterpart of organic reactions • Concept of ionic liquid, water, PEG as solvent • Idea about combinatorial chemistry and biomimetic synthesis • Knowledge about different alkaloids and terpenoids.
Practical: 1. 1. Acetylation of primary amine (preparation of acetanilide). 2. [4+2] Cycloaddition reaction (Diels-Alder reaction between furan and maleic anhydride). 3. Preparation of biodiesel from vegetable/waste cooking oil. 4. Photoreduction of benzophenone to benzopinacol in the presence of sunlight. 5. Pinacol-pinacolone rearrangement reaction (preparation of benzopinacolone). 6. Solid state synthesis of benzilic acid from benzil. 7. Benzoin condensation using thiamine hydrochloride as a catalyst instead of potassium cyanide. 8. Green multicomponent synthesis (three component coupling). 9. Base catalysed aldol		• Knowledge of carrying out different organic reactions in environmentally friendly manner

condensation (synthesis of dibenzal propanone from benzaldehyde and acetone). 10. Bromination of *trans*-stilbene using bromide/bromate mixture. 11. Preparation and characterization of gold nanoparticles using tea leaves. 12. Extraction of D-limonene from orange peel using liquid carbon dioxide.		