Kuvempu University

Department of PG Studies and Research in Chemistry
Jnanasahyadri, Shankaraghatta – 577451, India.

M.Sc. in Chemistry

Program Outcomes

After successful completion of two-year M.Sc. program in chemistry a student should be able to;

1. Explore jobs related to teaching and research.
2. Get research opportunities to pursue Ph.D. and programme targeted approach of GATE, CSIR –NET, examination.
3. Write competitive exams conducted by service commissions.
4. Develop interdisciplinary approach of the subject and able to work in teams as well as independently.
5. Progress in knowledge, understanding and proficiency in their chosen field of chemical science. Apply knowledge to build up small scale industry for developing endogenous product.
6. Opportunities in R & D and synthetic division of many industries.

Subject Outcomes
I - SEMESTER

ChHC-1.1: ANALYTICAL CHEMISTRY – I

After the completion of this course, the student would be able to;

1. Understand the classification of analytical methods like quantitative, qualitative instrumental and non-instrumental methods.
2. Study the classification of errors and its significance.
3. Understand the sequential simplex optimization, critical appraisal, treatment of multivariate data, factor analysis.

4. Study the Sampling techniques, sampling statistics, variability in the sample, sample stability.
5. Understand the concept of Need for qualityassurance; ISO 9000 series of quality system
6. Study the theory of indicators, indicator action,and preparation of indicator solutions, metal ion indicators, mixed indicators.
7. Understand the Classification of reactions in titrimetric analysis,neutralization titrations.
8. Study the Gravimetric estimations of – chloride as silver chloride, calcium as calcium.
9. Study electroanalytical techniques like Polarography, Cyclic voltametry, Amperometry and Electrogravimetry.
10. Study Chromatographic Method like PC, TLC, GLC, GC, SFC, HPLC and IEC.

ChHC-1.2: INORGANIC CHEMISTRY – I

After the completion of this course, the student would be able to;

1. Division of elements into s, p, d and f- blocks and learn their periodic trends.
2. Understand the transition and inner transition metal properties.
3. Learn the important features of chemical bonding, like valence bond theory (VBT) and molecular orbital theory (MOT).
4. Understand the comparison between;

i) bonding and anti-bonding molecular orbitals,

ii) sigma and pi molecular orbitals,

iii) atomic and molecular orbitals, bond order, molecular orbital configurations of A_2 and AB types of molecules.

5. Know the valence-shell electron-pair repulsion theory (VSEPR).
6. Explain the hybridization, structure and geometry of – AB_2, AB_3, AB_4, AB_5, $AB_2(lp)$, $AB_3(lp)$, $AB_2(lp)_2$, $AB_4(lp)$, $AB_3(lp)_2$, $AB_2(lp)_3$, $AB_5(lp)$, $AB_4(lp)_2$type species.
7. Predicting the hybridization, structure and geometry of interhalogen and xenon compounds.
8. Differentiate crystalline and amorphous solids.
9. Understand the conductors, semiconductors, insulators, superconductivity and superconducting materials.
10. Acquire the thorough knowledge on magnetic properties such as paramagnetic, diamagnetic, ferromagnetic, anti-ferromagnetic and ferromagnetic substances.

ChHC-1.3: ORGANIC CHEMISTRY – I

After the completion of this course, the student would be able to;

1. Understand the properties of electron delocalization, resonance and aromaticity.
2. Convert different aromatic molecules into one another by aromatic electrophilic substitutions.
3. Derive the reaction mechanism of Addition, Elimination and Nucleophilic substitution reactions of different organic compounds.
4. Evaluate the Stereochemical properties of different organic compounds.
5. Understand various terminologies in stereochemistry,will be able to draw the Stereochemical structures of different molecules.
6. Interpret reactivity of aromatic compounds.
7. Express the methods of determination of reaction mechanism.
8. Recognize regioselectivity and stereoselectivity of different organic reactions.
9. Understand the concepts of different reactive intermediates with examples.

Ch.HC-1.4: PHYSICAL CHEMISTRY-I

After study of this paper, students learn the following aspects:

1. Know important concepts of Thermodynamics
2. Study The Maxwell's relation, Thermodynamic equation of state, Chemicalpotential.
3. Study fugacity and activity coefficient and its determination.
4. Study third law of thermodynamics, Nernst heat theorem and Gibbs-Duhem equation.
5. Study basics of Classical Statistical Mechanics
6. Understand Boltzmann distribution law, Fermi – Dirac statistics, Bose –Einstein Statistics
7. Study partition function, relation of the partition function to the thermodynamicfunction and Determination of Partition functions.
8. Study the rate of reactions, rate law, rate constant and methods of determination of order of reactions.
9. To understand kinetics of reactions in solution.
10. Study the activity and activity co-efficients on ionic strength
11. Derive the Debye- Huckel-Bronsted equation.
12. Understand the electrochemical energy systems and fundamentals of batteries.

ChHCL-1.1: INORGANIC CHEMISTRY PRACTICALS – I

After the completion of this course the student would be able to;

1. Learn the complexometric titrations: estimation of amount of calcium, magnesium, copper, lead, nickel.
2. Become proficient in redox titrations: estimation of amount of Fe(II) and Fe(III) by $K_2Cr_2O_7$, ceric ammonium sulphate and vanadium solution.
3. Become competent in gravimetric estimations:copper as copper thiocyanate, sulphate as barium sulphate,nickel as nickel dimethyl glyoximate,lead as leadchromate.

ChHCL-1.2: ORGANIC CHEMISTRY PRACTICALS – I

After the completion of this course, the student would be able to;

1. Know meaning of safety signs and safety in handling of chemicals.
2. Know handling of glass wares in laboratory.
3. understand various laboratory methods to determine structure of unknown organic sample.
4. Understand different purification techniques in organic chemistry likerecrystallization, distillation, steam distillation and extraction.
5. Understand Systematic separation of organic binary mixtures of solid type using chemical and physicalmethods.
6. Perform Melting point determination, functional group analysis in the laboratory.
7. Correlate the reaction mechanisms with practical procedures.
8. Identify organic compounds.

Ch.HCL-1.3: PHYSICAL CHEMISTRY PRACTICAL –I

After the completion of this course, the student would be able to;

1. Explain the rate of reaction in the presence of catalyst.
2. Study the ionic activity on electrode and carried out practical experiment by using the conductometric instrument.
3. Study the electron transfer reaction and conduct the potentiometer experiments.
4. Students find out the dissociation constant value by using the potentiometer.
5. To determine the amino acid isoelectric point.
6. Able to find out the viscosity by using viscometer.

II - SEMESTER

ChHC-2.1: ANALYTICAL CHEMISTRY – II

After the completion of this course, the student would be able to;

1. Understand the nature and interaction of electromagnetic radiation with matter, types of molecular spectra and selection rules of electronic spectra.
2. Study the Woodward-Fischer rules for calculating absorption maximum of different conjugated systems.
3. Understand the concepts of vibration motion of a diatomic molecule, force constant, bond strengths, vibration-rotation spectroscopy and its characteristic features.
4. Study important concepts of Infrared Spectroscopy and its role in structure elucidation of organic compounds
5. Understand the basic theory and instrumentation of Raman Spectroscopy
6. Study the important concept of FES, AAS, AES, Molecular luminescence spectroscopy.
7. Understand the introduction, theory and principles of size exclusion and affinity chromatograpy.
8. Study the important concept of solvent extraction.
9. Study the theory, instrumentation and applications of electrophoresis.

ChHC-2.2: INORGANIC CHEMISTRY – II

After the completion of this course, the student would be able to;

1. Learn the concept of acids and bases.
2. Study the relative strength of oxy acids.
3. Acquire the thorough knowledge Preparation, structure and reactivity of borazine, substituted borazines.
4. Understand the polymeric compounds of sulphur: nitrides of sulphur (preparation, structure and properties).
5. Learn the structure and bonding, topological approach to boron hydride structure (styx numbers), preparation, structure and properties.
6. Develop a thorough knowledge on the metal clusters: Di, tri and tetra nuclear clusters (structure, synthesis and properties).

7. Thorough understanding the coordination chemistry: effective atomic number, stability of complex ions, stability constants, factors affecting the stability of complexes (nature of metal ion, ligand, chelate effect)

ChHC-2.3: ORGANIC CHEMISTRY – II

After the completion of this course, the student would be able to;

1. Understand the General mechanistic treatment of Nucleophilic, electrophilic and free-radical
   Rearrangements
2. Derive the reaction mechanism of Rearrangements reactions involving migration to electron deficient Nitrogen, Oxygen, Carbon.
3. Also Derive the reaction mechanism of Rearrangements reactions involving migration to electron rich Carbon.
4. Draw various organic reactive intermediates with stereochemistry.
5. Interpret the reactions and properties of different oxidizing and reducing reagents involving in organic reactions with suitable examples.
6. Recognize structure and function of different reagents.
7. Distinguish different types of reagents and Stereochemical outcomes in organic chemistry.
8. Write different preparation methods for reagents involving in organic reactions.
9. Use of reagents.

Ch.HC-2.4: PHYSICAL CHEMISTRY-II

After the completion of this course, the student would be able to;

1. Understand the Schrödinger equation for one dimensional time dependent.
2. Understands the wave function, normalization and orthogonality and basic postulates of quantum chemistry.
3. Learn the particle in box with different potential barrier.
4. Understand the theoretical treatment of rigid and non-rigid rotator.
5. Study the vibrational spectra of diatomic and polyatomic molecules.
6. Understand the review of laws of photochemistry.
7. Understand the solar energy and storage.
8. Study the dosimetry and safety measures against radiation hazards.

9. Study the types of polymer and determination of average molecular weight by different methods.
10. Learn the kinetics of polymerization.

ChHCL-2.1: INORGANIC CHEMISTRY PRACTICALS – II

After the completion of this course, the student would be able to;

1. Acquire the knowledge of ore analysis: Amount of;
   - calcium carbonate in limestone by oxalate method.
   - iron present in hematite ore.
   - MnO2 present in the given pyrolusite ore.
   - nitrite present in sodium nitrite ore solution.
2. Expertness in estimation of amount of :
   - Available chlorine in bleaching powder.
   - Available O_2 in Hydrogen peroxide.
   - Chromium and manganese in steel sample
   - copper present in $CuSO_4$ solution.
   - Copper and Iron in a solution mixture.
   - Nickel and Iron in a solution mixture.
   - Ascorbic acid.
   - Chlorate in potassium chlorate solution.

ChHCL-2.2: ORGANIC CHEMISTRY PRACTICALS – II

After the completion of this course, the student would be able to;

1. Know how to synthesize organic molecules?
2. Understand how to maintain reaction conditions?
3. Know how to follow reaction by using thin layer chromatography?
4. Know calibration of pipettes and burettes, preparation of standard solutions in quantitave analysis of organic compounds.
5. Understand two step syntheses of organic compounds.
6. Develop interest in writing and finding mechanisms of new reactions.

Ch.HCL-2.3: PHYSICAL CHEMISTRY PRACTICALS –II

After the completion of this course, the student would be able to;

1. Determine the mean ionic activity co-efficient of weak acid.
2. Find out the pH of strong acid, weak acid and neutral solution.
3. Understand equivalent conductance at the infinite dilution for strong electrolytes
4. To study the Precipitation titration by conductometrically.
5. Conduct the spectrophotometric/colorimeter experiments.
6. To Study the Heat of solution by carboxylic acids.

III - SEMESTER

ChSC-3.1: ANALYTICAL CHEMISTRY – III

After the completion of this course, the student would be able to,

1. Understand the concept of symmetry elements and symmetry operations of different molecules.
2. Study the properties of point groups and group multiplication tables of C_{2V} and C_{3V}.
3. Understand the Infrared and Raman activity ofmolecules belong to C_{2v}(H_2O, ClF_3, *cis*-N_2F_2) and C_{3v}(NH_3) point groups.
4. Study important concepts of 1H NMR spectroscopy and its rolein structure elucidation of organic compounds.
5. Understand the concepts of advanced NMR (COSY, 2D NMR and HETCOR) and C^{13} NMR techniques.
6. Study important concepts of Mass spectrometry and its role in structureelucidation of organic compounds
7. Understand the basic principles, instrumentation, experimentaltechniques and applications of ESR spectroscopy.
8. Study the basic principles, instrumentation, experimentaltechniques and applications of Mossbauer and NQR spectroscopy.
9. Evaluate the differences between ESR , Mossbauer and NQR spectra.

ChSC-3.2: INORGANIC CHEMISTRY – III

After the completion of this course, the student would be able to;

1. Understand the orientation of d-orbitals and crystal field splitting of energy levels intetrahedral and octahedral complexes
2. Learn the colour of transition metal complexes, modified crystal field theory (ligand field theory), evidence of covalent bonding in metal ligand bonding.
3. Knowledge of crystal field effects, spinel and inverse spinel. John-Teller distortion in octahedral complexes.
4. Predicting the electronic spectra of atoms – spectroscopic terms, classification of microstates, coupling of single electron angular momenta.
5. Predicting the Tanabe-Sugano diagrams, Orgel diagrams and ground term symbols. selection rules.
6. Understand the reactions, kinetics and mechanism - substitution reaction in octahedral complexes (associative and dissociative mechanism).
7. Learn the oxidation-reduction reactions: Classification of redox reactions, inner-sphere and outersphere mechanisms.
8. Develop a thorough knowledge on photochemical reactions: prompt and delayed reactions, d-d and charge-transfer reactions, transition in metal-metal bonded systems.
9. Study of 18-electron rule, electron counting in complexes, metal carbonyl complexes, preparation and properties of carbonyl complexes.
10. Understand the catalysis by organometallic compounds: Importance and mechanism of - Alkene hydrogenation (Wilkinson's catalysis), hydroformylation (Oxo-process), Monsanto acetic acid process, Wacker process (Smidt process), Ziegler-Natta polymerization.

ChSC-3.3: ORGANIC CHEMISTRY – III

After the completion of this course, the student would be able to;

1. Design different named reactions in organic chemistry.
2. Understand the Concepts of Coupling reactions.
3. Nomenclature of heterocyclic compounds.
4. Write different synthetic methods and reactivity of simple and fused heterocyclic compounds.
5. Understand the Concepts of Mesoionic compounds.

6. Express the differences between Bonding and antibonding orbitals, singlet and triple states in photochemistry.
7. Write and express modes of energy transfers from the excited states using Jablonski diagram.
8. Design different photochemical and pericyclic reactions.
9. Utilize their knowledge for various photochemical and heterocyclic conversions.

Ch.HC-3.4: PHYSICAL CHEMISTRY-III

After the completion of this course, the student would be able to;

1. Derive the application of Schrodinger wave equation to harmonic oscillator, rigid rotor and H-atom.
2. To solve the Schrodinger equation using various approximation methods like variation method and Perturbation method.
3. Understand the SCF method for many electron systems.
4. Learn the Slater orbitals.
5. Study the Huckel molecular orbital theory.
6. Study the adsorption by solids, liquids and gases.
7. Derive the Freundlich, Langmuir adsorption theories,BET theory and Gibbs adsorption isotherm.
8. Study the modern techniques for investigating surfaces.
9. Understand the catalysis like acid-base and derive the Michelis Menten equation.
10. Study the Kinetics of surfaces reactions.
11. Learn the colloidal systems, classification, preparation and properties and determination size of colloids.

ChHCL-3.1: INORGANIC CHEMISTRY PRACTICAL – III

After the completion of this course, the student would be able to;

1. Acquire thorough skills with the following complex preparations:
    - Mercurytetrathiocyanatocobaltate(II)complex.
    - Chloropentamminecobalt(III)chloride complex.
    - Bisoxalatocuprate(II)di hydrate complex.
    - Tris-oxalatoferrate(III) complex.
    - Sulphatotristhioureazinc(II) complex.

- Tristhioureacopper(I)sulphate complex
- Cis and trans Diaquadioxalatochromate(III)complex.

2. Acquire thorough skills with the following complex analysis:
    - Cobalt present in a given chloropentamminecobalt(III)chloride complex.
    - Copper and Oxalate present in a given bisoxala to cuprate(II)-di hydrate complex.
    - Iron and Oxalate present in a given Trisoxalatoferrate(III) complex.
    - Fe(III) using thiocyanite as ligand.
    - metal ligand composition by jobs method of continuous variation.

ChHCL-3.2: ORGANIC CHEMISTRY PRACTICAL – III

After the completion of this course, the student would be able to;

1. Know the methods to synthesize drug molecules.
2. Synthesize dyes such as methyl orange, Fluorescein, Crystal violet etc.
3. Apply various aspects of chemistry in natural products isolations.
4. Structure elucidation of natural products.
5. Various chemical conversions of natural products.
6. Understand handling of seperatory funnel in the extraction process.
7. Understand distillation of Solvents.
8. Learn the concepts of Drying agents.

Ch.HCL-3.3: PHYSICAL CHEMISTRY PRACTICAL –III

After the completion of this course, the student would be able to;

1. To study the reaction by using colorimetric measurements.
2. Determine the COD.
3. To understand the phase diagram for three component system.
4. Study the kinetics of oxidation of alcohols.
5. Learn the adsorption charecteristics.
6. Estimate the iodine, nitrite.
7. Understand the corrosion rate measurement.
8. Study the unknown concentration by spectrophotometric methods and Polarography

IV - SEMESTER

ChSC-4.1: ANALYTICAL CHEMISTRY – IV

After the completion of this course, the student would be able to;

1. Understand the basic steps involved in the structure elucidation of organic compounds
2. Determine the structural elucidation of different organic compounds.
3. Study the theory, instrumentation and its applications of X-Ray diffraction techniques.
4. Study the basic principle, instrumentation and its applications of electron and neutron diffraction techniques
5. Study the automatic methods of analysis.
6. Study Thermoanalytical Methods like TGA, DTA and DSC and its applications.
7. Learn the definition of solid surface, types of surface measurements and spectroscopic surface methods.
8. Understand the Basic principles, instrumentation and applications of XPS, AES, SEM, STM and AFM.

ChSC-4.2: INORGANIC CHEMISTRY – IV

After the completion of this course, the student would be able to;

1. Understand the essential and trace metal ions in biological process, bioligands- amino acids, proteins, nucleic acids, nucleotides and their potential metal binding sites;
2. Predict the ion transport across cell membrane.
3. Study of biological oxygen carriers,electron transfer proteins,metalloenzymes.
4. Learn the concept and scope of environmental chemistry, environmental segments, natural cycles of the environment.
5. Explain the Bio-Warfare agents, environment and public health.
6. Study of air pollutant accidents.
7. Knowledge about chemistry of new materials: Conducting polymers.
8. Understanding the super conductors- introduction, type I and type II super conductors.
9. Study of supra molecular chemistry: Definition, nature of supra molecular interactions; supra molecular host-guest compounds, common host molecules- crown ethers, porphyrins.

ChSC-4.3: ORGANIC CHEMISTRY – III

After the completion of this course, the student would be able to;

1. Understand an overview of the field of natural products in chemistry.
2. Identify different types of Carbohydrates, amino acids and Proteins, their structure, biosynthesis and properties.
3. Design preparation methods of Naural products.
4. Write Classification of vitamins and Physiological significance of Vitamin.
5. Learn the different types of alkaloids, terrenes and their chemistry and medicinal importance.
6. Understand Stereochemistry and structural elucidation of Cholesterol and related steroids.
7. Understand the concepts of Nucleic acids.
8. Design Crick-Watson model of DNA, structure of RNA.

Ch.HC-4.4: PHYSICAL CHEMISTRY - IV

After the completion of this course, the student would be able to;

1. Study the Fundamentals and importance of nanomaterials.
2. Learn the carbon nanoparticles.
3. Understand the preparation methods of nanomaterials.
4. Understand the Electrode potential and Its applications.
5. Study the principles and preparation of electroplates.
6. Study the types, methods and problems in corrosion.
7. Understand the phase rules for different systems.
8. Study the fundamentals and basic principles in Electrosynthesis
9. Learn the electrooxidation and reductions in electro organic reactions.

ChPR-4.1: PROJECT WORK

After the completion of this project, the student would be able to;

1. Have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical Chemistries.
2. Understand the literature survey and collection of research articles.
3. Understand good laboratory practices and safety.
4. Design a synthetic route and able to carry out synthesis of important compounds.

5. Get a skill in problem solving and analytical reasoning as applied to scientific problems.
6. Understand the techniques of spectroscopy such as IR, Mass, ^{1}H NMR ^{13}CNMR in structural elucidation.
7. Understand Analytical techniques such as chromatography, Distillation etc.
8. Understand instrumentations handling like IR, UV and Electroanalyser.
9. Communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large.

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