ACHARYA INSTITUTE OF GRADUATE STUDIES

(NAAC Re-Accredited 'A' Grade & Affiliated to Bengaluru City University)

Soladevanahalli, Bengaluru-560107

DEPARTMENT OF CHEMISTRY

NAME OF THE PROGRAM: MASTER OF SCIENCE IN CHEMISTRY

COURSE OUTCOMES (CO'S)

COURSE SPECIFIC OUTCOMES

ODD SEM

FIRST SEMESTER

PAPER: Ch-101 INORGANIC CHEMISTRY

After undertaking the course, the students will be able to,

1. Explain the bonding in coordination compounds.

2. Understand the chemistry of main group elements- Boranes, carboranes, metallocarboranes, Borazines, phosphazenes, S-N compounds, metal carbonyls and metal clusters, silicates, HSAB concept, stereoisomerism and nuclear Chemistry.

PAPER: Ch -102 ORGANIC CHEMISTRY

After undertaking the course, the students will be able to,

1. Understand the nature of bonding in organic molecules and reaction mechanisms
2. Explain the organic compounds like carbohydrates and heterocyclic compounds.

PAPER: Ch -103 PHYSICAL CHEMISTRY

QUANTUM MECHANICS-I

After performing the experiments, the students will be able to,

1. Differentiate between classical and quantum mechanics
2. Solve time-dependent and time-independent Schrödinger equation for simple potentials
3. Learn to apply concepts from physics and methods from mathematics to derive and understand the properties of chemical systems that arise from quantum mechanical models for the structure of atoms and molecules.

4. Study the postulates of quantum mechanics and the quantum mechanical model of the hydrogen atom
5. Quantitative reasoning and problem-solving skills with quantum chemistry as a context.
6. Understand and differentiate between different theories of kinetics.
7. Study kinetics of auto catalytic reactions, acid base catalyzed reactions and Kinetics of enzyme catalyzed reactions.
8. Understanding the surface phenomena like Adsorption, mechanism of adsorption, factors affecting Adsorption, difference between adsorption and types of adsorption isotherms.

PAPER: Ch -104 ANALYTICAL CHEMISTRY

After undertaking the course, the students will be able to,

1. Detailed knowledge on Safety measures to be followed in chemical laboratories
2. Obtain skills in different laboratory titrations and the theory behind titrimetric and gravimetric analysis.
3. Develop basic knowledge regarding the evaluation of analytical data
4. Know the different analytical techniques involved.
5. Obtain knowledge about chromatographic techniques employed.
6. Discuss the problem based on distribution coefficient and extraction techniques.

PAPER: Ch -105 MATHEMATICAL CONCEPTS FOR CHEMISTS

After undertaking the course, the students will be able to,

1. Develop the skills of applying existing mathematical skills and understanding to chemical problems.
2. Ability to apply of matrix and determinant methods to solve simple problems such as those found in Huckel theory.
3. Determine the values of overlap and other integrals
4. Observe logs and exponentials to convert between quantities such as transmittance and absorbance
5. Examine the nature of Fourier transforms, logs and exponentials to convert between quantities such as *K*a and p*K*a, $[H^+]$ and pH.
6. Asses the accuracy and precision of measurements

PAPER: Ch -106 INORGANIC CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Analyze the ions present in inorganic salt mixture.

PAPER: Ch -107 INORGANIC CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Prepare the complexes and estimate the percentage of ions present in inorganic complexes.

PAPER: Ch -108 PHYSICAL CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Understand an appreciation for modern problems and scientific controversies in physical chemistry.
2. Design and perform experiments to determine the rate, order, and activation energy of chemical reactions by varying concentrations and/or temperature.
3. Prepare of buffer solutions at a required pH, given a choice of solutions of acid/conjugate base pairs
4. Determine the solubility of sparingly soluble salts

PAPER: Ch -109 PHYSICAL CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Understand the principle and mechanism of conductormetric and potentiometric titrations
2. Communicate the results of scientific experiments in oral and written reports
3. Keep records of instruments, parameters, and experimental observations
4. Maintain high standards of professional and scientific ethics

THIRD SEMESTER

PAPER: Ch -301 ORGANIC REACTION MECHANISM

After undertaking the course, the students will be able to

1. Define the fundamental principles of aliphatic substitution reactions, free radical reactions, and advanced organic photochemistry, pericyclic reactions and biochemical reactions.
2. Describe reactivity, effects and stereochemistry in reaction to justify the mechanism involved in the formation of manifolds of organic compounds
3. Determine the mechanistic role through organic reaction, orbital inclusion and biochemical pathway in conversion of substrates to functionalised organic frameworks
4. Deduce the stability in formation of organic scaffolds
5. Distinguish the competitive reaction steps and conditions
6. Application of basic to advanced knowledge to design and develop the organic molecules

PAPER: Ch -302 ORGANIC SYNTHESIS

After performing the experiments, the students will be able to,

1. Define the named organic reactions in C-C and C-N bond forming reactions, oxidation and reduction reactions.
2. Describe reactivity and stereochemistry in reaction to justify the mechanism involved in the formation of manifolds of organic compounds.
3. Determine the reaction paths and intermediate for the organic reactions using Isotopic labelling, isotopic effect and from stereochemical evidence.
4. Discuss the throughput on available stereoselective methods to synthesiz asymmetric molecules.
5. Visualize the basics and applicability of reagents in organic synthesis.
6. 6. Application of synthetic knowledge to design and develop the organic molecules

PAPER: Ch -303 ORGANIC SPECTROSCOPY

After undertaking the course, the students will be able to

1. Enumerate the theories, principles and rules in organic spectroscopy
2. Interpret Spectral data: UV-Visible, Mass, Infrared, 1D and 2D Proton Nuclear Magnetic Resonance and 13C Nuclear Magnetic Resonance.

3. Identification of organic functional groups/fragments by interpreting the spectral values to assign these values and predict the structure of organic molecules
4. Validate the chemical structure in a systematic manner.

PAPER : Ch -305 OC ORGANIC CHEMISTRY PRACTICAL – I

After performing the experiments, the students will be able to,

1. In the laboratory the student shall perform hands on experiments by examine and identify the theoretical concepts related to organic chemistry.
2. Discuss the throughput on available chemical resources, methods to synthesize organic Molecules.
3. Determine the structural aspects in relevance with theoretical base values in analytical, Spectroscopic and chemical methods
4. Apply chemical correlations and rules to identify the synthesised of organic molecules.
5. Estimate the amount of organic molecule obtained from the experiment.
6. Adapt the various skills to design and develop new organic molecule.

PAPER: Ch -306 OC ORGANIC CHEMISTRY PRACTICAL – II

After performing the experiments, the students will be able to,

1. In the qualitative analysis of organic compounds the give compound is preliminary observed.
2. Identify the aliphatic and aromatic nature of the organic compound by chemical test.
3. Detect the elements present in the given organic compound.
4. Classify the solubility groups
5. Predict the functional group present in the organic compound using chemical tests
6. Prepare the suitable functional group derivative and find the melting point of its.

PAPER: Ch -307 OC ORGANIC CHEMISTRY PRACTICALS

TWO STAGE PREPARATIONS

After performing the experiments, the students will be able to,

1. Memorize the fundamental principles of general chemical reactivity and solution chemistry

2. Extend their knowledge in organic synthesis to derive simple organic molecules of studied reactions by means of the protocols, recrystallization and determining the physical constants.

3. Examine practical approaches in the regular lab experiments.
4. Devise synthetic methods that yield such similar derivatives.
5. Categorize the required practical setups: apparatus and instrumentation

PAPER: Ch -308 OC ORGANIC CHEMISTRY PRACTICALS

QUALITATIVE ESTIMATIONS: TITRIMETRIC ESTIMATIONS

After performing the experiments, the students will be able to,

1. Memorize the theoretical principles of analytical methods within titrations
2. Classify the titrations
3. Examine the unknown samples by acid-base titrimetric method and determine the endpoints for quantitative measurement
4. Categorize the required practical setups: apparatus and instrumentation

EVEN SEM

SECOND SEMESTER

PAPER: Ch -201 INORGANIC CHEMISTRY

After undertaking the course, the students will be able to,

1. Understand the metal ligand equilibria in solutions.
2. Comprehend the structure and bonding in hydride, dihydrogen, dioxygen, isocyanide, N2 tertiary phosphine complexes of transition metals, metal carbonyls-terminal and bridge carbonyls, metal nitrosyls- terminal (linear and bent) and bridge.
3. Explain the colour, magnetic, electronic and photochemical properties of coordination compounds.

PAPER: Ch -202 ORGANIC CHEMISTRY

After undertaking the course, the students will be able to,

1. Understand the nature of bonding in organic molecules and reaction mechanisms such as aromatic substitution reactions, addition reactions, elimination reactions, rearrangements of some selected functions groups.
2. Explain the organic compounds like carbohydrates and heterocyclic compounds.

PAPER: Ch -203 PHYSICAL CHEMISTRY

After undertaking the course, the students will be able to,

1. Know about the concepts of activity and activity coefficients and determination of activity coefficient
2. Familiarize the Partial molar properties and its determination.
3. Learn about the chemical potential and its determination
4. Study the concept of thermodynamic probability.
5. Explain the Maxwell – Boltzmann, Fermi – Dirac and Bohr's Einstein statistics Comparison and applications.
6. Obtain knowledge about the Partition functions
7. Perform calculations based on the irreversible and non-equilibrium thermodynamics.
8. Discuss the theory of Debye-Huckel rule, limitations and its applications.
9. Demonstrate Butler- Volmer equation for one step and multi-step electron transfer reaction
10. Describe the structure of electrical double layers of Helmholtz, perrin-Guoy-chapman
11. Understand and be able to use basic electrochemical concepts and relationships for analysis of electrochemical processes
12. Describe fully the relationship between cell potential and the equilibrium constant
13. Obtain a basic idea about polarography, its theory and applications
14. Explain various types of advanced electrodes and their applications

PAPER: Ch -204 SPECTROSCOPY

After undertaking the course, the students will be able to,

1. Identify the symmetry and point group of molecules.
2. Understand the vibrations of molecules, harmonic and anharmonic oscillators, vibrational-rotational spectra of diatomic molecules, P, Q and R branches, break down of the Born-Oppenheimer approximation.
3. Comprehend the Rotations of molecules, rigid diatomic molecule- rotational energy expression, energy level diagram, rotational wave functions and their symmetry, selectioin rules.

4. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and symmetric top molecules.
5. Interpret electronic structure of diatomic molecules- basic results of MO theory, classification of states by electronic angular momentum.

PAPER: Ch -205 PHOTOCHEMISTRY

After undertaking the course, the students will be able to,

1. Understand fundamentals of photochemistry and laws governing it such as Beer-Lambert law.
2. Explain and discuss theories for photoinduced electron transfer and excitation energy transfer, and apply these methods in quantitative calculations.
3. Describe the interaction of excited states with their surroundings, and apply theoretical methods for treating excited states.
4. Express the term symbols and Franck-Condon principle.
5. Explain theory and application of photocatalysis and explain the environmental impact of atmospheric photochemistry.
6. Explain the mechanisms of common photochemical transformations, analyse them theoretically, and describe the significance of conical intersections in photochemical reactions.
7. Describe photoinduced processes in semiconductors, and explain how these can be used for photophysical energy conversion.

PAPER: Ch -206 INORGANIC CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Estimate the amount of Cu, Fe, Zn, Ni, and Cr ions present in inorganic complexes gravimetrically.

PAPER: Ch -207 INORGANIC CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Estimate the amount of Cu, Fe, Zn, Ni, and Cr ions present in inorganic complexes volumetrically.

PAPER: Ch -208 PHYSICAL CHEMISTRY PRACTICALS

After performing the experiments, the students will be able to,

1. Prepare for each experiment by studying lab handouts and links therein
2. Demonstrate the relative strength of two acids
3. Develop understanding of the professional and safety responsibilities residing in working with chemical systems.

PAPER: Ch -209 PHYSICAL CHEMISTRY PRACTICAL'S

After performing the experiments, the students will be able to,

1. Know about the safety requirements and lab skills to perform physico-chemical experiments
2. Explain the principle and mechanism of Conductormetric and potentiometric titrations
3. Develop skills in the scientific method of planning, developing, conducting, reviewing and reporting experiments

FOURTH SEMESTER

PAPER: Ch -401 STEREOCHEMISTRYAND RETROSYNTHETIC ANALYSIS

After undertaking the course, the students will be able to

1. Enumerate the principles of advanced stereochemistry and retrosynthetic analysis.
2. Describe the chemical correlations and rules to identify the optically active organic compounds and study reversal organic reaction to simplest organic substrates
3. Imagine and examine the three-dimensional structures and retrospective thinking to ensure suitable synthons and synthetic equivalents
4. Evaluate and distinguish the synthetic approaches to achieve a suitable mechanism
5. Application of basic to advanced knowledge to design and develop the chiral and simple organic molecules.

PAPER: Ch -402 CHEMISTRY OF NATURAL PRODUCTS

After undertaking the course, the students will be able to

1. Visualize the basics and applicability of reagents, chemical pathway and biochemical pathway
2. Discuss the throughput on available natural resources, methods to synthesize natural products and elucidations
3. Determine the structural aspects in relevance with theoretical base values in analytical, spectroscopic and chemical methods
4. Illustrate the elucidation of a few synthesized natural products
5. Application of synthetic knowledge to design and develop the organic molecules

PAPER: Ch -403 INDUSTRIAL ORGANIC CHEMISTRY

After undertaking the course, the students will be able to

1. Define the fundamental principles of organometallic compounds, heterocyclic compounds, dyes and polymers.
2. Describe the methods to synthesis organometallic compounds, heterocyclic
3. Compounds, dyes and polymers.
4. Distinguish the competitive reaction steps and conditions.
5. Identification and analysis of organometallic and heterocyclic compounds in medicinal applications and dyes and polymers in everyday life
6. Adapt the commercial synthetic routes to design and develop.

PAPER: Ch -404 MEDICINAL ORGANIC CHEMISTRY

After undertaking the course, the students will be able to

1. Define the major aspects in synthesis and identification of medicinally important organic compounds.

2. Describe theories, QSAR, computer modeling technique in identification of medicinal chromophores

3. Determine the commercial synthetic routes to develop

4. Application of synthetic knowledge to design and develop the structurally diverse medicinal organic molecules.

PAPER: Ch -405 ORGANIC CHEMISTRY PRACTICAL'S

TWO OR THREE STAGE PREPARATIONS

After undertaking the course, the students will be able to

1. Memorize the fundamental principles of general chemical reactivity and solution chemistry
2. Extend their knowledge in organic synthesis to derive simple organic molecules of studied reactions by means of the protocols, recrystallization and determining the physical constants.
3. Examine practical approaches in the regular lab experiments.
4. Devise synthetic methods that yield such similar derivatives.
5. Categorize the required practical setups: apparatus and instrumentation

PAPER: Ch -406 ORGANIC CHEMISTRY PRACTICAL'S

QUANTITATIVE ESTIMATIONS: TITRIMETRIC ESTIMATIONS

After undertaking the course, the students will be able to

1. Memorize the theoretical principles of analytical methods within titrations
2. Classify the titrations.
3. Examine the unknown samples by acid-base titrimetric method and determine the endpoints for quantitative measurement.
4. Categorize the required practical setups: apparatus and instrumentation

PAPER: Ch -407 ORGANIC CHEMISTRY PRACTICAL'S

SPECTRAL ANALYSIS/INSTRUMENTATION

After undertaking the course, the students will be able to

1. Enumerate the theories, principles and rules in organic spectroscopy
2. Interpret Spectra: UV-Visible, Mass, Infrared, 1D and 2D Proton Nuclear Magnetic Resonance and 13C Nuclear Magnetic Resonance.
3. Identification of organic functional groups/fragments by interpreting the spectra to assign these values and predict the structure of organic molecules
4. Validate the chemical structure in a systematic manner.

PAPER: Ch -408 OC ORGANIC CHEMISTRY PRACTICAL'S

QUALITATIVE ANALYSIS OF BINARY MIXTURES

After performing the experiments, the students will be able to

1. Memorize the theoretical principles of analytical methods within titrations
2. Classify the titrations
3. Examine the unknown samples by acid-base titrimetric method and determine the endpoints for quantitative measurement
4. Categorize the required practical setups: apparatus and instrumentation