

**M.S. Ramaiah University of Applied Sciences**

New BEL Road, MSR Nagar, Bangalore – 560054



**RAMAIAH  
UNIVERSITY**  
OF APPLIED SCIENCES

## **PO, PSO, PEO & CO**

**Programme Name: M.Sc. (Analytical Chemistry)**

**Programme Code: 082**

**Programme Outcome (PO)**

**Programme Specific Outcome (PSO)**

**Program Educational Objectives (PEO)**

**Course Outcomes (CO)**

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M.S. Ramaiah University of Applied Sciences  
Bangalore-560058

**Registrar**  
M.S. Ramaiah University of Applied Sciences  
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# Faculty of Mathematical & Physical Sciences

Programme Name: M.Sc. (Analytical Chemistry)

## Programme Outcomes (PO's)

M.Sc. graduates will be able to:

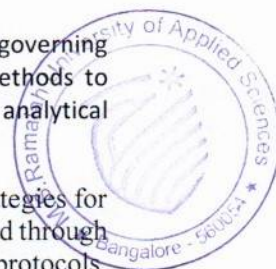
- PO-1. Scientific Knowledge:** Apply fundamental knowledge of chemical Sciences to solve real life problems in their chosen domain
- PO-2. Knowledge, Dissemination and Administration:** Teach in schools, colleges and universities with relevant training and perform administrative duties in government, semi-government, private and public sector organizations
- PO-3. Problem Solving:** Understand and solve scientific problems by conducting experimental investigations
- PO-4. Modern Tool Usage:** Apply appropriate tools, techniques and understand utilization of resources appropriately in various laboratories
- PO-5. Research:** Conduct scientific research and disseminate the knowledge in the chosen domain
- PO-6. The Science, Society and Ethics:** Understand the effect of scientific solutions on legal, cultural, social, public health and safety aspects, and apply ethical principles to scientific practices and professional responsibilities
- PO-7. Environment and sustainability:** Develop sustainable solutions and understand their effect on society and environment
- PO-8. Individual and teamwork:** Work as a member of a team, to plan and to integrate knowledge of various disciplines and to lead teams in multidisciplinary settings
- PO-9. Communication:** Make effective oral presentations and communicate technical ideas to a broad audience using written and oral means
- PO-10. Life-long learning:** Adapt to the changes and advancements in science and engage in independent and life-long learning

## Programme Specific Outcomes (PSOs)

At the end of the M.Sc. (Analytical Chemistry) programme, the graduate will be able to:

- PSO-1.** Apply the knowledge of Chemistry to identify and explain basic laws and principles governing physical and chemical systems, use mathematical, statistical and computational methods to analyze industrially important materials, explain their properties, adopt suitable analytical techniques to obtain the required outcomes.
- PSO-2.** Model and explore alternative materials and processes in an industry, develop strategies for commercial viability of a processes and products, solve and interpret results obtained through experimentation, adopt safe handling practices and perform duties as per scientific protocols, demonstrate to work as an individual, and as a leader.
- PSO-3.** Demonstrate ethics, leadership qualities, communication, managerial, entrepreneurial skills and involvement in lifelong learning for the betterment of organization, environment and society.

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## Program Educational Objectives (PEOs)

The objectives of the M.Sc. (Analytical Chemistry) Programme are to:

- PEO-1. To provide students the fundamental knowledge of chemistry to enable them to deliver efficient solutions for complex scientific problems using analytical and cognitive skills in their chosen domain.
- PEO-2. To enable students to apply appropriate tools, techniques, methods and understand utilization of resources in laboratories and computational skills in their chosen domain and work as an individual as well as lead team in multidisciplinary settings.
- PEO-3. To inculcate ethics, environmental sustainability, and communication, soft, managerial and entrepreneurial skills for a successful career in industries and to engage in lifelong learning and also work towards developing sustainable society.

## Course Outcomes (COs)

Course Title & Code: Physical Chemistry 1 (CYC511A)

After the successful completion of this course, the student will be able to:

- CO-1. Explain the laws of thermodynamics, concepts in photochemistry, JT effect, Raoult's law, and Henry's law to the physical transformation of substances
- CO-2. Discuss the theories of kinetics, concepts in quantum mechanics, phase diagram construction and electrochemistry
- CO-3. Illustrate quantum mechanical systems such as particle in a box, hydrogen atom, orbitals, electron systems, kinetics of complex & fast reactions
- CO-4. Apply the principles of chemical & enzyme kinetics to determine the energetics of chemical reactions and assess the effect of catalyst on the outcome of reaction kinetics, laws of electrochemistry to estimate chemical compounds, applications of Schrodinger wave equation and thermodynamic processes
- CO-5. Solve problems based on quantum mechanics and chemical/enzyme kinetics, electrochemistry, colloids, colligative properties, Phase equilibria and thermodynamics

## Course Outcomes (COs)

Course Title & Code: Inorganic Chemistry 1 (CYC512A)

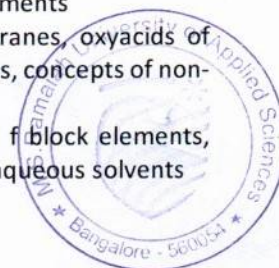
After the successful completion of this course, the student will be able to:

- CO-1. Outline the principles of electron filling in the atomic orbitals, VSEPR theory, molecular orbital theory, wades rule, polymorphism, magnetic property d and f-block elements and acid-base concepts and non-aqueous solutions.
- CO-2. Differentiate between VSEPR and MO theory/CFT, closo/nido/arachno boranes, structure of silicates and phosphates, electronic configuration in d and f-block elements and its consequences
- CO-3. Explain with examples the industrially important compounds, inorganic molecules by VSEPR theory, structure of ionic crystals, defects in crystals, acid- base concepts, closo/nido/arachno boranes, structure of silicates and phosphates, super heavy elements
- CO-4. Discuss the structure and bonding in solids, borazines, metallocarboranes, oxyacids of nitrogen, phosphorous sulfur halogens, intercalated compounds, silicates, concepts of non-aqueous solvents, polarizability and partial covalent character
- CO-5. Illustrate the potential applications of main group compounds, d and f block elements, boranes carboranes silicates phosphates, metallo carboranes and non aqueous solvents



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## Course Outcomes (COs)

Course Title & Code: Organic Chemistry 1 (CYC513A)

After the successful completion of this course, the student will be able to:

- CO-1. Discuss the principles of structure and bonding, acid base concepts, reactive intermediates, stereochemistry, vitamins and carbohydrates
- CO-2. Illustrate the reaction mechanism and stereochemistry of the molecules and structural elucidation of natural products
- CO-3. Identify the reagents, reactive intermediates, reaction mechanism, stereochemistry of heterocyclic compounds, carbohydrates and other molecules
- CO-4. Apply the basic concepts of synthesis of heterocyclic molecules, carbohydrates, reactive intermediates for the synthesis of new molecules
- CO-5. Recommend reagents, reactive intermediates, reaction mechanism, stereochemistry for synthesis of small organic molecules

## Course Outcomes (COs)

Course Title & Code: Instrumental Methods of Analysis (CYC514A)

After the successful completion of this course, the student will be able to:

- CO-1. Outline the working principle and instrumentation of mass, optical, electron and X-ray and NMR spectroscopic techniques, chromatography, microscopy, thermal, X-ray diffraction, electrochemical and radio analytical techniques
- CO-2. Analyze the morphology of materials using optical, electron and probe type microscopy techniques
- CO-3. Interpret thermal properties of materials using TGA, DTA and DSC techniques
- CO-4. Identify and analyze the appropriate chromatographic techniques for separation and analysis of chemical compounds
- CO-5. Interpret the structure and/or determine concentration of chemical compounds using UV-Visible, Infrared, Raman, NMR, mass spectroscopy and voltammetry techniques.

## Course Outcomes (COs)

Course Title & Code: Physical Chemistry Laboratory (CYL515A)

After the successful completion of this course, the student will be able to:

- CO-1. Setup the experimental apparatus required to achieve the stated aim
- CO-2. Conduct experiments as per the standard procedures and tabulate the measured values
- CO-3. Calculate the required parameters and plot the results
- CO-4. Interpret and draw conclusions
- CO-5. Write laboratory report as per the prescribed format.



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## Course Outcomes (COs)

Course Title & Code: Qualitative & Quantitative Analysis of Inorganic Compounds (CYL516A)

After the successful completion of this course, the student will be able to:

- CO-1. Setup the experimental apparatus required to achieve the stated aim
- CO-2. Conduct experiments as per the standard procedures and tabulate the measured values
- CO-3. Calculate the required parameters and plot the results
- CO-4. Interpret and draw conclusions
- CO-5. Write laboratory report as per the prescribed format.

## Course Outcomes (COs)

Course Title & Code: Seminar 1 (CYS517A)

After the successful completion of this course, the student will be able to:

- CO-1. Conduct a thorough literature review and submit a review article / scientific report
- CO-2. Make a presentation to a panel of examiners

## Course Outcomes (COs)

Course Title & Code: Physical Chemistry 2 (CYC521A)

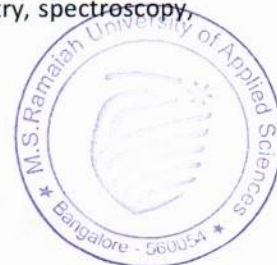
After the successful completion of this course, the student will be able to:

- CO-1. Classify the polymers, mechanisms of enzyme, chemical kinetics, adsorption isotherms, wave functions and thermodynamic functions
- CO-2. Outline the chemistry & properties of polymers, mechanism & kinetics of polymerization, term symbols, perturbation theory, factors affecting surface activity and overpotential, RS and JJ-coupling. Spin-orbital interaction and term multiplicities, Zeeman effect
- CO-3. Discuss the principles of quantum mechanics approximate methods, rotational, vibrational, Raman and electronic spectra, theories & kinetics of electrochemistry, corrosion of metals, polarography, amperometry, effect of various parameters on activity of catalysts/enzymes, theories of unimolecular reactions, radial and angular distribution function and their significance
- CO-4. Apply the spectroscopic information to determine structure & properties of compounds, thermodynamic concepts & laws to determine nature of chemical interactions, various parameters which can influence catalysis to predict the surface activity/chemical reactions, electrochemical theories and properties to understand various electrochemical systems and quantum mechanical concepts in real life problems
- CO-5. Solve numerical based on electrochemistry, polymers, quantum chemistry, spectroscopy, kinetics, thermodynamics and surface chemistry

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## Course Outcomes (COs)

Course Title & Code: Inorganic Chemistry 2 (CYC522A)

After the successful completion of this course, the student will be able to:

- CO-1. Outline the principles of the character table construction, Orgel diagrams and molecular orbital theory and correlate to the crystal structures, spectroscopic and magnetic properties of coordination complexes, stereochemistry of the co-ordination numbers from 2 to 6
- CO-2. Differentiate between closo/nido/arachno boranes, ligand substitution mechanism in square planar and octahedral complexes, d-d transition and charge transfer spectra
- CO-3. Predict the properties of a coordination complexes from the molecular orbital theory and LFT, and explain Metal ion storage and transport properties of biological systems, Factors affecting stability constant in solution
- CO-4. Discuss the concepts of group theory, chemistry of solid state materials, bonding and structures in organometallic compounds, the relevance of Orgel diagrams and transport and storage of dioxygen; haemoglobin, myoglobin and phenomenon of cooperativity, stability constants
- CO-5. Illustrate the potential applications of organometallic compounds and metal complexes; gold complexes and platinum complexes in medicine; Photosynthesis; chlorophyll, PS I, PS II, Biochemical importance of NO, Role of Ca in signal transduction, porphyrins, nitrogen fixation

## Course Outcomes (COs)

Course Title & Code: Organic Chemistry 2 (CYC523A)

After the successful completion of this course, the student will be able to:

- CO-1. Discuss the reactive intermediates, stereochemistry, oxidation and reduction, molecular rearrangements reaction mechanisms, pericyclic reactions, sigmatropic reactions, heterocyclic compound synthesis, named reaction, natural products, nucleic acids, protein structure and reagents in organic synthesis
- CO-2. Illustrate nucleophilic, electrophilic, radical reactions, specific reagents for oxidation and reduction, heterocyclic reactions and organometallic reagents
- CO-3. Identify heterocyclic motifs, reagents, named reaction, molecular rearrangements, stereochemistry in natural products and drug molecules
- CO-4. Apply named reaction, heterocyclic synthesis, and organic reagents for synthesis of natural and pharmaceutically important products
- CO-5. Design small organic molecules considering factors such as stereochemistry and reagents for various applications

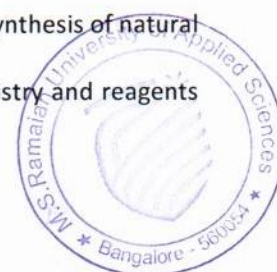
## Course Outcomes (COs)

Course Title & Code: Computational Methods in Chemistry (CYC524A)

After the successful completion of this course, the student will be able to:

- CO-1. Differentiate theoretical approaches such as HF(Hartree-Fock), DFT(Density Functional Theory) and force field methods
- CO-2. Identify various methods for simulating/modeling various scientific problems and discuss

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- their advantages/disadvantages
- CO-3. Illustrate the principles of differentiation, integration and data modeling
  - CO-4. Assess and recommend suitable computational chemistry tool for theoretical predictions
  - CO-5. Apply semi-empirical and computational modeling to make theoretical predictions of outcome of a reaction, suitable methods for calculating electronic properties of simple molecules and crystals

### Course Outcomes (COs)

**Course Title & Code: Computational Techniques in Chemistry (CYL525A)**

**After the successful completion of this course, the student will be able to:**

- CO-1. Plan the experimental setup to achieve the stated aim
- CO-2. Conduct experiments as per the standard procedures and tabulate the measured values
- CO-3. Calculate the required parameters and plot the results
- CO-4. Interpret, compare with standard results and draw conclusions
- CO-5. Write laboratory report as per the prescribed format

### Course Outcomes (COs)

**Course Title & Code: Qualitative and Quantitative Analysis of Organic Compounds (CYL526A)**

**After the successful completion of this course, the student will be able to:**

- CO-1. Setup the experimental apparatus required to achieve the stated aim
- CO-2. Conduct experiments as per the standard procedures and tabulate the measured values
- CO-3. Calculate the required parameters and plot the results
- CO-4. Interpret and draw conclusions
- CO-5. Write laboratory report as per the prescribed format.

### Course Outcomes (COs)

**Course Title & Code: Seminar 2 (CYS527A)**

**After the successful completion of this course, the student will be able to:**

- CO-1. Conduct a thorough literature review and submit a review article / scientific report
- CO-2. Make a presentation to a panel of examiners

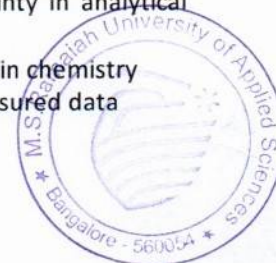
### Course Outcomes (COs)

**Course Title & Code: Data Analysis and Statistical Inference (CYC631)**

**After the successful completion of this course, the student will be able to:**

- CO-1. Discuss the concepts of various types of errors, estimation of uncertainty in analytical techniques and methods for calibration of the analytical techniques
- CO-2. Justify the use of data analysis and statistical treatment to analytical data in chemistry
- CO-3. Apply various statistical treatment methods for the evaluation of the measured data
- CO-4. Identify the sources of uncertainty in the measured data

  
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- CO-5. Analyze the analytical data to represent, preprocess, model and classify using chemometric techniques

### Course Outcomes (COs)

Course Title & Code: Advanced Analytical Chemistry Techniques (CYC632A)

After the successful completion of this course, the student will be able to:

- CO-1. Discuss the concepts of NMR, polarography, surface analysis types and techniques in identification / estimation of compounds
- CO-2. Elucidate the structure of molecules using UV, IR, NMR (1D and 2D) and mass spectral data
- CO-3. Analyze the molecular arrangement on the surfaces of materials using mass spectroscopy by SIMS, dynamic SIMS, low-energy ion scattering and Rutherford back scattering, surface structure from SPM data
- CO-4. Estimate the chemicals qualitatively and quantitatively by polarography, coulometry and electrogravimetry and interpret the data obtained
- CO-5. Evaluate the use of chemosensors and biosensors for environmental monitoring and process control

### Course Outcomes (COs)

Course Title & Code: Analysis of Biopharmaceuticals and Foods (CYC633A)

After the successful completion of this course, the student will be able to:

- CO-1. Discuss the methods for the therapeutic drug monitoring, methods of determining quality and purity of biopharmaceutical & food products
- CO-2. Illustrate the techniques used in food analysis and to monitor the quality of biopharmaceutical products
- CO-3. Outline various processes involved in biopharmaceuticals, role and methods of pigment analysis in food preservation and degradation, working principles of various instruments used in the analysis of biopharmaceutical and food products
- CO-4. Analyze the impurities in biopharmaceuticals and residue of pesticide/ fumigant in diverse foods
- CO-5. Identify and justify suitable analytical techniques for the evaluation of biopharmaceuticals and food products

### Course Outcomes (COs)

Course Title & Code: Environmental Analytical Chemistry (CYC634A)

After the successful completion of this course, the student will be able to:

- CO-1. Identify air, water and soil of pollutants in the environment
- CO-2. Apply suitable methods for pollution control
- CO-3. Discuss the principles of techniques used for measurement of air, water and soil pollutants
- CO-4. Suggest and evaluate the methods to remediate radioactive and other contaminants in soil and water
- CO-5. Recommend techniques for measurement of soil and water pollutants in the environment





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## Course Outcomes (COs)

Course Title & Code: Research Methodology (MPF615A)

After the successful completion of this course, the student will be able to:

- CO-1. Describe the value, scope, relevance and mandatory steps of research as well as principles of effective research
- CO-2. Discuss and demonstrate the application and utility of the Systematic approach and out of box thinking concepts for research to be effective
- CO-3. Explain and apply the procedures outlined for a systematic Literature Review
- CO-4. Outline the principles to prepare a well-structured research proposal and research paper
- CO-5. Identify and apply the essential skills desirable for an effective technical presentation

## Course Outcomes (COs)

Course Title & Code: Analytical Chemistry Laboratory 1 (CYL636A)

After the successful completion of this course, the student will be able to:

- CO-1. Setup the experimental apparatus required to achieve the stated aim
- CO-2. Conduct experiments as per the standard procedures and tabulate the measured values
- CO-3. Calculate the required parameters and plot the results
- CO-4. Interpret and draw conclusions
- CO-5. Write laboratory report as per the prescribed format

## Course Outcomes (COs)

Course Title & Code: Analytical Chemistry Laboratory 2 (CYL637A)

After the successful completion of this course, the student will be able to:

- CO-1. Setup the experimental apparatus required to achieve the stated aim
- CO-2. Conduct experiments as per the standard procedures and tabulate the measured values
- CO-3. Calculate the required parameters and plot the results to perform computational studies
- CO-4. Interpret and draw conclusions
- CO-5. Write laboratory report as per the prescribed format.

## Course Outcomes (COs)

Course Title & Code: Seminar 3 (CYS638A)

After the successful completion of this course, the student will be able to:

- CO-1. Conduct a thorough literature review and submit a review article / scientific report
- CO-2. Make a presentation to a panel of examiners



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## Course Outcomes (COs)

Course Title & Code: Internship (CYI641A)

After the successful completion of this course, the student will be able to:

- CO-1. Write a report on experiences during internship
- CO-2. Make a presentation to a panel of examiners

## Course Outcomes (COs)

Course Title & Code: Seminar (CYS641A)

After the successful completion of this course, the student will be able to:

- CO-1. Conduct a thorough literature review and submit a review article
- CO-2. Make a presentation to a panel of examiners

## Course Outcomes (COs)

Course Title & Code: Dissertation (CYP642A)

After the successful completion of this course, the student will be able to:

- CO-1. Recognize the need for developing a new or improving an existing scientific problem through an organized survey of literature
- CO-2. Define scientific problem
- CO-3. Design and perform the experiments
- CO-4. Analyse the results obtained
- CO-5. Write a technical Report and give presentation

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