# Ph.D.

## School of Chemistry

**(Based on UGC – Learning Outcomes-Based Curriculum Framework)**

**Vision Statement:**

To be the source of knowledge and center of training that imparts a sound foundation in chemical sciences with strong transdisciplinary reach, and spawns original and innovative research in contemporary and futuristic chemical themes.

**Mission Statements:**

- Providing quality chemical sciences education at masters and doctoral levels
- Conducting fundamental and advanced research in chemical sciences
- Establishing research collaborations with other universities/institutes/laboratories
- Carrying out sponsored research and development projects from international/national government and private partners

## Qualification Descriptors (QDs)

Utilizing basic knowledge and research experience gained in chemical sciences to:

QD-1 analyze, interpret and rationally explain chemically relevant observations

QD-2 identify critical scientific issues and develop innovative solutions

QD-3 create/cultivate new generations of human resource in chemical sciences

QD-4 formulate and develop original research avenues to address scientific problems

## Mapping Qualification Descriptors (QDs) with Mission Statements (MS)

| | **MS-1** | **MS-2** | **MS-3** | **MS-4** |
|---|---|---|---|---|
| **QD-1** | 3 | 3 | 1 | 1 |
| **QD-2** | 3 | 3 | 1 | 1 |
| **QD-3** | 3 | 3 | 2 | 1 |
| **QD-4** | 3 | 3 | 3 | 3 |

## Program Learning Outcomes (PLOs)

After going through the 5/6 years of study, the doctorate degree holder can use the comprehensive knowledge and research experience gained, to:

PLO-1: solve essential and challenging problems in fundamental/applied research

PLO-2: design and develop new molecules/processes with industrial and societal applications

PLO-3: formulate new ideas/concepts in chemical sciences and explore their finer details

PLO-4: communicate effectively the principles and practice of chemical research

PLO-5: develop solutions to critical environment, health and development issues

PLO-6: follow professional ethics in all spheres of activity

PLO-7: function effectively as a member/leader in diverse teams/groups

PLO-8: engage in innovative learning process in the broadest context of scientific advancement

## Mapping of Program Learning Outcomes (PLOs) with Qualification Descriptors (QDs)

| | QD-1 | QD-2 | QD-3 | QD-4 |
|---|---|---|---|---|
| **PLO-1** | **3** | **3** | **2** | **2** |
| **PLO-2** | **3** | **3** | **2** | **3** |
| **PLO-3** | **3** | **3** | **2** | **3** |
| **PLO-4** | **2** | **2** | **3** | **2** |
| **PLO-5** | **2** | **2** | **3** | **3** |
| **PLO-6** | **1** | **1** | **3** | **2** |
| **PLO-7** | **3** | **3** | **3** | **3** |
| **PLO-8** | **3** | **3** | **3** | **3** |

**Course Code : CY-801**
**Title of the Course : Research Methodology**

**L-T-P** : L /~~T~~/ P
**Credits** : 4 – 0 – 0

**Prerequisite Course / Knowledge (If any):** M.Sc. in Chemistry or allied areas

## Course Learning Outcomes (CLOs)

**After completion of this course successfully, the students will be able to……**

**CLO-1 :** explain and understand the basic concepts of research

**CLO-2 :** identify various sources of information for literature review and data collection

**CLO-3 :** appreciate the components of scholarly writing and evaluate its quality

**CLO-4 :** read and understand scientific literature, analyze the content and imbibe the critical message in the reports

**CLO-5 :** formulate ideas and present them in a logical manner as scientific reports

**CLO-6 :** prepare scientific writing in the form of research proposals, scientific articles or reviews, in a clear and precise language

## Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs)

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 |
|---|---|---|---|---|---|---|---|---|
| **CLO-1** | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| **CLO-2** | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 3 |
| **CLO-3** | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 |
| **CLO-4** | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 |
| **CLO-5** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CLO-6** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Detailed syllabus (CY-801)**

This course is a mandatory requirement for the Ph.D. course work. The objective is to help research students understand the purpose and process of technical and research writing and documentation.

**Course implementation**

The course has two parts.

- Part A: Lectures on **Academic Writing** (scientific and technical writing).
- Part B: Preparation of a **Research Proposal**. The student will prepare and defend a research proposal based on self-study. The proposal will be evaluated by the doctoral review committee (DRC). The defense will involve presentation in a seminar.
- Evaluation of the course will be as follows:
    - Part A: 10 marks from the evaluation based on the theory classes
    - Part B: 50 marks from the DRC based on proposal evaluation + 40 marks from the assessment of the presentation of the proposal.

**Part A: Lecture plan**

**Academic Writing (Scientific and Technical Writing) (10 contact hours)**

1. Types of research communication: Full length research paper, brief communications, letters to editor, review article, popular non-technical article, research proposal
2. Structure of Writing: Title of the manuscript, Abstract, Key words, Introduction, Materials and methodology, Results, Data presentation: figures, tables and legends, Discussion/Conclusion, Acknowledgement, Conflict of interest statement, References.
3. Literature survey and Plagiarism
4. Writing skill: Elements of writing (argument and discussion, cause and effect, definitions); Writing Vocabulary and language (grammar, voice, clarity, academic vocabulary, word choice, Commas, parentheses, dash skewers Argument)

**Reference books**


1. Scientific writing and Communication: papers, proposals, and presentations, by Angelika H. Hofmann, Publisher: Oxford University Press [2017].
2. American Chemical Society and Royal Society of Chemistry publications and webinars.

**Course Code : CY-805**
**Title of the Course : Instrumental Methods A (Analytical Techniques)**

**L-T-P** : L ~~/ T /~~ P
**Credits** : 2 – 0 – 2

## Course Learning Outcomes (CLOs)

**After completion of this course successfully, the students will be able to……**

**CLO-1:** provide basic principles of various instrumental methods

**CLO-2:** understand the basic concepts and their use

**CLO-3:** analyze and interpret outputs from various instrumental methods

**CLO-4:** design and execute an instrumental measurement

**CLO-5:** apply different instrumental methods to understand structure and bonding of a compound

## Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs)

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 |
|---|---|---|---|---|---|---|---|---|
| **CLO-1** | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 |
| **CLO-2** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 |
| **CLO-3** | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 3 |
| **CLO-4** | 3 | 3 | 3 | 2 | 3 | 3 | 2 | 3 |
| **CLO-5** | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 |

## Detailed syllabus (CY-805)

The course is expected to provide training in the use of various instruments and software. The student will work as apprentice for short periods with instrument operators or senior students. The courses may include special lectures by the faculty as well as performing some assignments. Each course will have a faculty-in-charge who will evaluate and award grade based on input from the various instrument-in-charges and performance in assignments.

**Recommended modules:**

NMR, Mass spectrometry, Absorption / Fluorescence / CD spectroscopy, Polarimetry, Computer software.

**Course Code : CY-806**
**Title of the Course : Instrumental Methods B (Physical Measurements)**

**L-T-P** : L – T – P
**Credits** : 4 – 0 – 0

**Prerequisite Course / Knowledge (If any):** None

**Course Learning Outcomes (CLOs)**

**After completion of this course successfully, the students will be able to……**

**CLO-1 :** observe and recognize the basics of different instruments function (X-Ray Diffraction techniques, Electro Chemistry, Magnetic measurements, Calorimetry, Microscopy) for chemical analysis.

**CLO-2:** understand and recognize various molecular solid state structure/magnetic/redox/ thermodynamic/ and nanostructures

**CLO-3 :** realize the concepts of various instrumental techniques for the analysis of diverse chemical compounds in various forms (crystals/films/powder).

**CLO-4 :** design a combination of different instrumental techniques to analyses the chemicals in various size scales (macro to nano).

**CLO-5 :** understand the importance of design and development of new instrumental techniques for societal needs.

**Mapping of Course Learning Outcomes (CLOs) with Program Learning Outcomes (PLOs)**

| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** | **PLO 7** | **PLO 8** |
|---|---|---|---|---|---|---|---|---|
| **CLO-1** | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 3 |
| **CLO-2** | 3 | 2 | 2 | 2 | 3 | 1 | 1 | 3 |
| **CLO-3** | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 3 |
| **CLO-4** | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 |
| **CLO-5** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

## Detailed syllabus (CY-806)

The course is expected to provide training in the use of various instruments and software. The student will work as apprentice for short periods with instrument operators or senior students. The courses may include special lectures by the faculty as well as performing some assignments. Each course will have a faculty-in-charge who will evaluate and award grade based on input from the various instrument-in-charges and performance in assignments.

One of the two courses, CY-805 / CY-806 has to be taken as part of the mandatory requirement of the Ph.D. course work.

**Recommended modules** (can be modified based on requirements/equipment availability):

Diffraction techniques, Microscopy, Calorimetry, Electrochemistry, Magnetic measurements, Computer software.