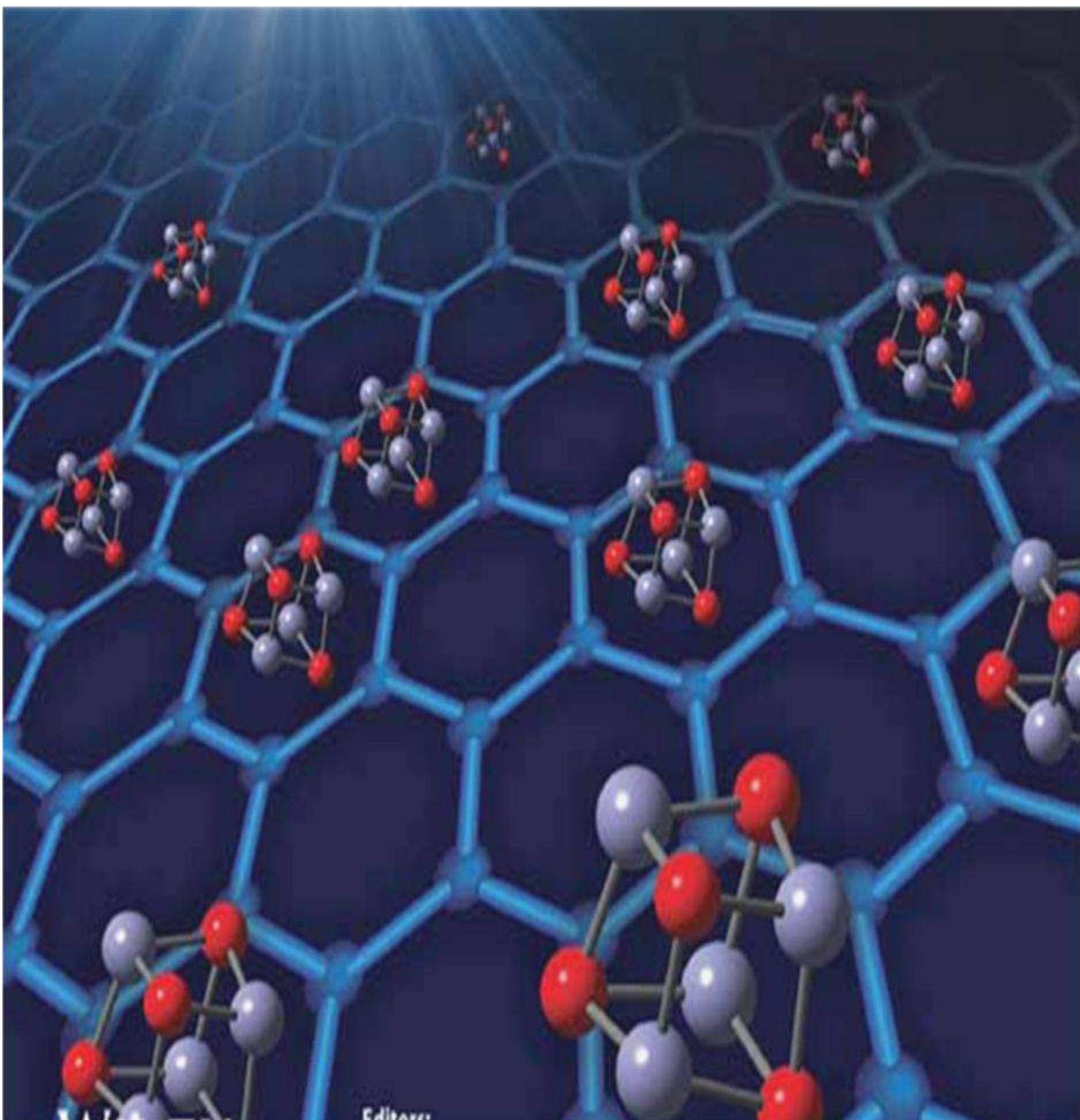




# Ph.D Programme Chemistry



Department of Chemistry  
School of Basic and Applied Sciences  
Central University of Tamil Nadu  
Thiruvarur - 610 005

## Preamble

The doctoral degree in Chemistry at CUTN is an exciting research programme with components of course work and advanced research. The department is seeking enthusiastic research scholars to work in frontier areas of Chemistry such as organic synthesis, organic electronic materials, carbohydrate chemistry, polymer chemistry, bioinorganic chemistry, materials chemistry, asymmetric synthesis, molecular modeling studies (DFT, ab-initio methods) and Fluorescence spectroscopy. The DST-INSPIRE fellows, CSIR-JRF and other national fellowship holders can approach the faculty based on their research interest at any time. University admit PhD students among NET/GATE qualified and also conduct entrance examination. With the guidance of well experienced faculty members, students are encouraged to brain storm original ideas. The laboratories at the department of chemistry are well equipped to cater the needs of students to perform advance level of research.

## Contents and Credits

| Year | Course Code    | Title of the Course             | Credits   |
|------|----------------|---------------------------------|-----------|
| 1    | <b>CHE4011</b> | Research Methodology            | <b>4</b>  |
| 1    | <b>CPE-RPE</b> | Research and Publication Ethics | <b>2</b>  |
| 1    |                | Elective - 1*                   | <b>4</b>  |
| 1    |                | Elective – 2*                   | <b>4</b>  |
|      |                | <b>Total credits</b>            | <b>14</b> |

**Semester I**  
**Credit: 4**

**Course Type: Theory**  
**Course Title: Research Methodology**

**Course Code: CHE4011**

## **OBJECTIVES**

- To understand the basic principles and different stages of scientific research
- To expertise in document, dissertation and patent writing
- To develop an understanding of various research designs and techniques
- To learn project management, good laboratory practices and lab safety
- To learn statistical tools

## **LEARNING OUTCOMES**

After the completion of the course, the scholars will be able to

- Understand the basic principles and different stages of scientific research
- Gain of knowledge and expertise for impacting quality research.
- Identify appropriate research topics and select and define appropriate research problem and parameters
- Expertise in surveying literature, document, dissertation writing
- Learn good laboratory practices, rules and safety
- Know safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals
- Manage project with quality and improvement in a more appropriate manner
- Expertise in patents and patenting.

### **UNIT- 1: Basics of Research and Literature Survey**

Basic principles and different stages of scientific research: observation, problem identification, hypothesis formulation, experimentation and conclusion. Characteristics of researchers: knowledge, curiosity, creativity, commitment, interpersonal skills, open-mindedness and integrity.

Sources of information–Primary, secondary and tertiary sources (journals, reviews, monographs, books and dictionaries)–Types of journal articles (communication, full papers, notes and reviews)–Journal abbreviations–Science Citation Index–Journal Impact factors, h-index, Chemical abstracts–Beilstein–E-Journals and books–UGC infonet–Search engines: Google Scholar, Scopus, Current Contents Connect, SciFinder and–ToC alerts.

### **UNIT-2: Methodology of Chemistry Document Writing**

Purpose of writing chemistry documents–Audience to chemistry documents–Importance of content, conciseness, grammar and formatting in chemistry writing–Tools for writing chemistry documents –Lab notebooks–Different sections of chemistry documents (IMRD format)–Details of writing abstract, introduction, results and discussion, conclusion and reference sections (ACS and RSC styles) of journal articles (read-analyze-write strategy)–Writing review articles, conference abstracts, posters, dissertations/theses–Preparing research proposals for grants. Shodhganga.

### **UNIT-3: Good Laboratory Practices and Safety**

Introduction: History, definition, principles, Good laboratory practices (GLP) and its application. GLP training: Resources, Rules, Characterization, Documentation, quality assurance, Resources, Facilities: building and equipment, Personnel, GLP and FDA, European Union, non-member countries. Stepwise implementation of GLP and compliance monitoring. Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation, Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric – safe storage and disposal of waste chemicals, recovery, recycling and reuse of laboratory chemicals, procedure for laboratory disposal of explosives, identification, verification and segregation of laboratory waste, disposal of chemicals in the sanitary sewer system, in incineration and transportation of hazardous chemicals.

### **UNIT- 4: Patents and Patenting**

Definitions and interpretation, criteria for patenting, types of inventions not patentable, patent application procedure, types of patent documents : provisional and complete specifications, publication and examination of patents, opposition proceeding to grant of patent, grant of patent, patent office and its establishment, patent agents, international arrangements while patenting. Exclusive Marketing Right (EMR) –Intellectual Property Rights (IPR) - Paris convention and its advantages – Patent Cooperation Treaty (PCT) and its applications - Non English patents.

### **UNIT- 5: Data Analysis**

Types of Error – Accuracy, precision, significant figures, use of calculation in the estimation of errors – Frequency distribution, the binomial distribution, the Poisson distribution and normal distribution – describing Data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements – Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t–Test, paired t–Test – Analysis of variance (ANOVA) – Correlation and Regression – Curve fitting, Fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals.

### **References:**

1. A. M. Coghill and L. R. Gardson, “The ACS Style Guide – Effective Communication of Scientific information”, 3rdEdn, Oxford University Press, 2006.
2. H. Beall and J. Trimbur, “A short Guide to Writing about Chemistry”, 2ndEdn, Longman, 2001.
3. M. S. Robinson, F. L. Stoller, M. S. Constanza-Robinson and J. K. Jones, “Write Like a Chemist”, Oxford University Press, 2008.
4. A.I. Vogel, “Quantitative Inorganic Analysis”, 3rd Ed., ELBS Longman London

5. J. March, 'Advanced Organic Chemistry; Reactions, Mechanisms and Structure', 6th Ed., Wiley– Interscience, 2016.
6. Good Laboratory Practice Standards: Applications for Field and Laboratory Studies (ACS Professional Reference Book) by Willa Y. Garner, Maureen S. Barge, and James.
7. Maeve O'Connor, 'Writing successfully in science' Chapman and Hall, London, 1995.
8. Chemical safety matters–IUPAC –IPCS, Cambridge Univ. Press, 1992.
9. Analytical Chemistry , K.Gopalan, S.Chand
10. D. B. Hibbert and J. J. Gooding, 'Data Analysis for Chemistry', Oxford University press, 2006.
11. J. Topping, 'Errors of Observation and Their Treatment', Fourth Edn., Chapman Hall, London, 1984
12. S. C. Gupta, 'Fundamentals of Statistics', Sixth Edn., Himalaya publ. House', Delhi, 2006
13. <http://www.inflibnet.ac.in>
14. <http://spingerlink.com>
15. <http://rsc.org>
16. <http://www.pubs.acs.org>
17. K. Arora, Ed., The Patents act, 1970 as amended by the patents Act 2005, Professional book publishers, 2005
18. Manual of patent practice and procedure, Patent office, India, 2008; [http: www. Patent office.nic.in/ipr/patent](http://www.Patentoffice.nic.in/ipr/patent).

**Semester I**  
**Credit: 2**

**Course Type: Theory**  
**Course Title: Research and Publication Ethics**

**Course Code: CPE-RPE**

## **OBJECTIVES**

- To introduce philosophy and scientific conduct
- To learn publication ethics and open access publications
- To learn about plagiarism software and citation index
- To create scientific awareness and different research metrics

## **LEARNING OUTCOMES**

After the completion of the course, the scholars will be able to

- Expected to learn about the ethical guidelines in carrying our research
- Ability to open access publications
- Expected to know the plagiarism software and research metrics
- Students should know scientific conducts

### **I. Theory**

#### **UNIT- 1: Philosophy and Ethics (3 hours)**

Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions

#### **UNIT- 2: Scientific Conduct (5 hours)**

Ethics with respect to science and research – Intellectual honesty and research integrity – Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP) - Redundant publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data

#### **UNIT- 3: Publication Ethics (7 hours)**

Publication ethics: definition, introduction and importance – Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest – Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types p violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals – Predatory publishers and journals.

### **II. Practice**

#### **UNIT- 4: Open Access Publishing (4 hours)**

Open access publications and initiatives – SHERPA / RoMEO online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested etc.

## **UNIT- 5: Publication Misconduct (4 hours)**

### **A. Group Discussions (2 hours)**

Subject specific ethical issues, FFP, authorship – Conflicts of interest – Complaints and appeals: examples and fraud from India and abroad

### **B. Software Tools (2 hours)**

Use of plagiarism software like Turnitin, Urkund and other open sources of software tools

## **UNIT- 6: Databases and Research Metrics**

### **A. Databases (4 hours)**

Indexing databases - Citation data bases : Web of Science, Scopus,etc.

### **B. Research Metrics (3 hours)**

Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score-Metrics: h-index, g-index, i10- index, altmetrics

## **References**

1. Bird, A. (2006). *Philosophy of Science*. Routledge.
2. MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.
3. P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865.
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.
5. Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1-10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
6. Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179-179. <https://doi.org/10.1038/489179a>
7. Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance* (2019), ISBN:978-81-939482-1-7. <http://www.insaindia.res.in/pdf/EthicsBook.pdf>

## List of Electives

| Course Code | Title of the Course                                   | Credits |
|-------------|---|---------|
| CHEE01      | Principles of Polymer Science                         | 4       |
| CHEE02      | Principles of Fluorescence Spectroscopy               | 4       |
| CHEE03      | Asymmetric Catalysis                                  | 4       |
| CHEE04      | Essentials of Carbohydrate Chemistry                  | 4       |
| CHEE05      | Organic Electronics                                   | 4       |
| CHEE06      | Photochemistry in Molecules and Materials             | 4       |
| CHEE07      | Medicinal Inorganic Chemistry                         | 4       |
| CHEE08      | Organic Semiconductors                                | 4       |
| CHEE09      | Advances in Polymer Science                           | 4       |
| CHEE10      | Advances in Carbohydrate Research                     | 4       |
| CHEE11      | Advanced Organic Materials and Catalysis              | 4       |
| CHEE12      | Chemistry of CH Activation                            | 4       |
| CHEE13      | Advanced Bio-inorganic Chemistry                      | 4       |
| CHEE14      | Principles of Biochemistry                            | 4       |
| CHEE15      | Mathematics for Chemists and Biologists               | 4       |
| CHEE16      | Electrochemical Energy Systems                        | 4       |
| CHEE17      | Fundamentals of Analytical Chemistry                  | 4       |
| CHEE18      | Computational Chemistry                               | 4       |
| CHEE19      | Advanced NMR Techniques                               | 4       |
| CHEE20      | Organometallics, Catalysis and Inorganic Spectroscopy | 4       |
| CHEE21      | Applications of Computational Methods in Chemistry    | 4       |
| CHEE22      | Chemical Lab Safety and Management                    | 4       |
| CHEE23      | Advanced Organic Synthesis                            | 4       |
| CHEE24      | Green Chemistry                                       | 4       |
| CHEE25      | Advanced Topics in Organometallic Chemistry           | 4       |
| CHEE26      | Industrial Chemistry                                  | 4       |
| CHEE27      | Advanced Organic Nanomaterials                        | 4       |
| CHEE28      | Computer software for Chemists                        | 4       |
| CHEE29      | Selected Experiments in Applied Chemistry             | 4       |
| CHEE30      | Luminescence Spectroscopy for Advanced Research       | 4       |
| CHEE31      | Nanoscience and Technology                            | 4       |

\*Electives will be appended based on the availability of faculty member.