

**BODOLAND UNIVERSITY**  
**Ph.D. COURSE WORK IN CHEMISTRY**  
(w. e. f. 2021)

*Approved in the 10<sup>th</sup> Academic Council Meeting held on 20-08-2021 vide Resolution No. 09*



**DEPARTMENT OF CHEMISTRY**  
Bodoland University  
Kokrajhar – 783 370  
Assam, India

**Department of Chemistry :: Bodoland University**

1. Name of the Course : **PhD Course Work in Chemistry**

2. Duration of the Course : **Six Months (*One Semester*)**

Paper	Course Code	Course Title	Credits	Marks			
				Seminar/ Assignment	Internal Exam	Final Exam	Total
Paper-1	PhD-CHM-1	RESEARCH METHODOLOGY	3	20	20	60	100
Paper-2	PhD-CHM-2	COMPUTER APPLICATION	3	20	20	60	100
Paper-3	PhD-CHM-3	ANALYTICAL TECHNIQUES IN CHEMISTRY	3	20	20	60	100
Paper-4	PhD-CHM-4	LITERATURE REVIEW	3	20 (Presentation)	20 (Viva)	60 (Report)	100
Paper-5	PhD-CHM-5	RESEARCH AND PUBLICATION ETHICS	2	-	-	50	50
<b>Total</b>			<b>14</b>				<b>450</b>

**PAPER-1**  
**RESEARCH METHODOLOGY (PhD-CHM-1)**

**Total Credit: 3**

**Marks = 100 (20+20+60)**

**Seminar/Assignment (20) + Internal exam (20) + Final exam (60)**

*Learning outcome:* Students will be able to understand and apply research methodology, unique features of scientific writings and demonstrate patent laws and process of patenting.

**Unit 1**

Research methodology: Research concept, identification of research gap. Understanding the scientific questions, novelty of research in support of existing literature, setting hypothesis and objectives, writing research proposal and synopsis.

**Unit 2**

Scientific writings: Forms of scientific writing i.e. research articles, notes, report, review, monograph, dissertation/thesis, popular article etc. components of research article, writing strategy for a research article.

**Unit 3**

Introduction to Patent laws: Patent laws, process of patenting a research finding, cyber laws.

**PAPER-2**  
**COMPUTER APPLICATION (PhD-CHM-2)**

**Total Credit: 3**

**Marks = 100 (20+20+60)**

Seminar/Assignment (20) + Internal exam (20) + Final exam (60)

**Learning outcome:** Students will be able to understand/demonstrate basic concepts of computer application and will be able to perform error analysis and curve fitting, use various software needed for research work and explain computational chemistry.

**Unit 1**

Operating system, System Software, Application Software.

Use of Microsoft office word in word processing, graphical presentation and preparation of documents.

Power Point in graphical presentation and preparation of documents, Creating and printing a presentation, producing a slide show.

Excel in data analysis, Editing and formatting worksheets, performing basic calculations, working with charts.

Browsing internet for related literature and Inter Groups for sharing of data and result.

**UNIT 2**

Error Analysis: Basics of a measurement and its interpretation, mean, standard deviation, variance, correlation coefficient.

**UNIT 3**

Curve Fitting: Linear and Non-linear fitting of data.

Usage of software packages (e.g. ORIGIN, JCPDS, ChemDraw, X'Pert HighScore, Mercury, MNova, ORTEP, ImageJ, Gaussian, etc).

Basics of computational chemistry.

### **PAPER-3**

#### **ANALYTICAL TECHNIQUES IN CHEMISTRY (PhD-CHM-3)**

**Total Credit: 3**

**Marks = 100 (20+20+60)**

Seminar/Assignment (20) + Internal exam (20) + Final exam (60)

**Learning outcome:** Students will be able to demonstrate and apply the unique features of spectroscopic, microscopic, chromatographic and other analytical techniques and solve related problems.

#### **Unit 1: SPECTROSCOPIC AND DIFFRACTION METHODS**

General principles, instrumentation and applications of the following spectroscopic techniques. Infrared Spectroscopy (IR), Roman Spectroscopy, Nuclear Magnetic Spectroscopy (NMR), Electron Spin Resonance (ESR), Mossbauer Spectroscopy, Nuclear Quadrupole Resonance (NQR) Spectroscopy, Fluorescence Spectroscopy, Atomic Absorption Spectroscopy (AAS), Atomic Emission spectroscopy (AES), Inductively Coupled Plasma Atomic Emission spectroscopy, UV/Visible Spectroscopy, Mass Spectroscopy, X-ray Photoelectron Spectroscopy (XPS) and X-ray diffraction (XRD) technique.

#### **Unit 2: MICROSCOPIC TECHNIQUES**

Working Principle, instrumentation and applications of Atomic Force Microscopy (AFM), Optical microscopy, Polarizing Optical Microscopy, Interference Microscopy, Fluorescence Microscopy, Scanning Probe Microscopy (SPM), Scanning Tunneling Microscopy (STM), Transmission Electron Microscopy (TEM), Techniques of preparing samples for microscopy, Fourier Transformation in Microscopy.

#### **Unit 3: THERMAL ANALYSIS**

Principles, instrumentation and applications of Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA), Thermal Conductivity, Thermal Diffusivity, Effusivity.

#### **Unit 4: CHROMATOGRAPHIC TECHNIQUES**

Principles, Instrumentation (basic components) and applications of gas chromatography, High Performance Liquid Chromatography (HPLC), Ion Exchange Chromatography: Size Exclusion Chromatography, Thin Layer Chromatography, Inverse Gas Chromatography.

#### **PAPER-4**

#### **LITERATURE REVIEW (PhD-CHM-4)**

**Total Credit: 3**

**Marks = 100 (20+20+60)**

**Presentation (20) + Viva (20) + Report (60)**

*Learning outcome:* Students will be able to understand how to perform literature review on published works and will be able to find out the research gap on a particular area including synopsis writing and solve related issues.

#### **REVIEW OF PUBLISHED RESEARCH IN THE RELEVANT FIELD**

Each student shall submit three hardbound copies of a review article separately based on published works in one of the following broad fields based on at least 50 relevant up-to-date references for evaluation.

1. Inorganic Chemistry
2. Organic Chemistry
3. Physical Chemistry
4. Analytical Chemistry

**PAPER-5**  
**RESEARCH AND PUBLICATION ETHICS (PhD-CHM-5)**

**Total Credit: 2**

**Marks = 50 (Final Exam)**

*Learning outcome:* Students will be able to demonstrate and explain the philosophy and ethic, scientific conduct and publication ethics, and will have the idea of open access publishing, publication misconduct, and various databases and research metrics and will be able to solve related problems.

## **I. THEORY**

### **Unit 1: Philosophy and Ethics**

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

### **Unit 2: Scientific Conduct**

1. Ethics with respect to science and research
2. Intellectual honesty and research integrity
3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
4. Redundant publications: duplicate and overlapping publications, salami slicing
5. Selective reporting and misrepresentation of data.

### **Unit 3: Publication Ethics**

1. Publication ethics: definition, introduction and importance
2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
3. Conflicts of interest
4. Publication misconduct: definition, concept, problems that lead to unethical behaviour and vice versa, types.
5. Violation of publication ethics, authorship and contributorship
6. Identification of publication misconduct, complaints and appeals.
7. Predatory publishers and journals

## **II. Practice**

### **Unit 4: Open Access Publishing**

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

### **Unit 5: Publication Misconduct**

#### **A. Group Discussions**

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

#### **B. Software Tools**

1. Use of plagiarism software like Turnitin, Urkund and other open source software tools

### **Unit 6: Databases and Research Metrics**

#### **A. Databases**

1. Indexing databases
2. Citation databases: Web of Science, Scopus, etc.

#### **B. Research Metrics**

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