

DOCTOR OF PHILOSOPHY IN CHEMISTRY

(Ph.D. Chemistry)

A FULL TIME REGULAR COURSE WORK

SYLLABUS

2022-2023



**P. G. DEPARTMENT OF CHEMISTRY,
FAKIR MOHAN UNIVERSITY,
VYASA VIHAR, BALASORE-756089
ODISHA, INDIA**

Ph. D. Chemistry

Programme Outcomes (POs)

PO1: Acquire the skills in handling scientific instruments, planning and performing in laboratory experiments. Enable capacity building by improving skill of getting success in research or industrial field.

PO2: Strengthen to communicate scientific information in a concise manner both orally as well as in writing to ensure effective presentations, and understand clear instructions thereof.

PO3: Improve scientific temper among the students to bring up research culture and implementation of the policies to take up the challenges of cutting-edge research at local-cum-global.

PO4: To develop indigenous product/technology and start-up research that would lead to get employability to the individuals in various industries including chemical, metallurgical, pharmaceutical, paint, lather, paper, polymer, pesticides and cosmetics- sectors.

PO5: To expedite techniques for the qualitative and quantitative analysis of chemicals in laboratories and in industries and impart knowledge as an individual and in a team through good analytical, design and implementation skills.

Ph. D. Chemistry

Programme Specific Outcomes (PSOs)

PSO1: To acquire knowledge in research prospective and command on execution of research studies in both in basic and applied domain of chemical Science.

PSO2: Able to carry out research project activity indispensably in the interdisciplinary subject research

PSO3: To developed ideas and experience on designing experiment, writing report, research paper, patent and research proposal.

Paper Code	Paper Name	Credit	Int. Mark	Ext. Mark
CH-711	RESEARCH METHODOLOGY and COMPTUER APPLICATIONS	6	40	60

Objectives	The basic objective of this course is to introduce students about the knowledge on back ground of research such as data collection, analysis, error calculation and computer calculation.
Pre-Requisites	Knowledge on basic concept of research and computer handling.
Teaching Scheme	Regular classroom lectures with use of chalk and black board. Sessions are planned to be interactive with focus on problem solving activities.

Unit-I:Objectives and types of research:

Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical.

Research Formulation – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs-patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

Unit-II:Research design and methods

Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design – Observation and Facts, Laws and Theories, Prediction and explanation, Induction, Deduction, Development of Models. Developing a research plan - Exploration, Description, Diagnosis, Experimentation. Determining experimental and sample designs.

Data Collection and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation.

Unit-III: Application of results and ethics

Environmental impacts - Ethical issues - ethical committees - Commercialisation – Copy right – royalty - Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement - Reproducibility and accountability.

Unit-IV: Computer I

Basic of Computer Operating System: Using Windows – Directory structures – command structure (Document preparation, EXCEL, Power Point Presentation).

Word Processing: Basics of Editing and Word processing.

Numerical analysis.

Figure Plotting: Figure insertions in documents.

Unit-V: Computer II

Web Browsing for Research: Usage of Webs as a tool for scientific literature survey.

Error Analysis: Basics of a measurement and its interpretation, mean, standard deviation, variance, correlation coefficient; Usage of packages (e.g. ORIGIN; EXCEL) for data analysis.

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

Course Outcome	At the end of the course, the students will be able to: i) Known the various concepts of research and data collection as well as copy right. ii) Able to known computer based calculation and paper writing.
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Reference:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, EssEss Publications. 2volumes.

4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.
6. I will teach you Excel by Joel Villar, CPA.
7. "O" level computer books by DOEACC.
8. Internet technology and web design by R.K. Jain

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F. M. University, Balasore

Paper Code	Paper Name	Credit	Int. Mark	Ext. Mark
CH-712	GENERAL CHEMISTRY	6	40	60

Objectives	The basic objective of this course is to introduce students about the clarity of knowledge on various measurement instruments as well as knowledge on various concepts of chemistry starting from waste water to spectroscopy as well as material chemistry.
Pre-Requisites	Knowledge on principle of various measurement instruments and basic concept of various topic of chemistry.
Teaching Scheme	Regular classroom lectures with use of chalk and black board. Sessions are planned to be interactive with focus on problem solving activities.

Paper-II (Chemistry)

UNIT – I: Importance of Materials in Chemical Reaction/Research

Nanomaterials, Composites Materials, Biomaterials, Graphene and its derivatives, Activated Materials, Sorbent materials, Ion exchanger, Biosensor, natural sorbents, Magnetic Materials etc. Preparation, Characterization and Application of nanoparticles (NPs)

UNIT – II: Material preparation methods

Sol gel synthesis methods, co-precipitation approach, electro nano biosynthesis, combustion, electrochemical approach on synthesis of NPs, Sealed Tube Methods, Special Atmosphere, Microwave (MW) Synthesis, High Pressure Methods, Chemical Vapor Deposition, Chemical Vapor Transport, Molecular Beam Epitaxy, Crystal Growth,

UNIT – III: Application of Analytical Techniques in Chemical Research

Advanced treatment of IR and UV-Visible Spectroscopy, DLS analysis, Atomic Absorption Spectroscopy (AAS), X-ray Diffraction (XRD), Fe-Scanning Electron Microscopy (SEM)-EDS, Fourier Transform Infrared Spectroscopy (FTIR), Transmission Electron Microscopy(TEM), Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES), Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA) , Differential scanning calorimetry (DSC), Brunauer–Emmett–Teller (BET), zeta potential, Mass

Spectrometry, Nuclear magnetic resonance (NMR), Raman, and Electron spin resonance (ESR). Spectrometric application; Circular dichroism (CD) and optical rotational dispersion (ORD) treatment at advanced level. Characterization and analysis of materials, water sample and organic samples.

UNIT – IV: Surface phenomena

Adsorption: Physio sorption, Chemisorption: Sorbent-sorbate interaction, Kinetics of various Adsorption Process: Active transport and passive transport, Multiple equilibria, examples of multiple equilibria, Transport processes; General features of transport processes; Optical systems for the study of transport processes, Self-organizing systems (Micelles, Lipids, Cyclodextrins, Liquid crystals, Reverse micelles) their interactions and solutions properties, Factors affecting the chemical reaction rate: temperature, ionic strength of the solution, catalyst, pH and dielectric constant of the medium, micelle, reverse micelle & nanoparticles (NPs); rate constant determination by stopped flow method & relaxation method; Flash photolysis.

UNIT – V: Waste water treatments, process and managements

Physicochemical properties of water; Sources of pollution (for surface water, ground water, marine water, industrial effluents); Effects of water pollution on aquatic organisms and human health; Basic concepts on water quality analytical parameters. Waste water treatment processes (Characteristics of domestic, industrial and municipal waste water, primary, secondary and tertiary treatment methods); Sludge digestion processes; Drinking water treatment processes (Ion exchange, Reverse Osmosis, Ozonisation, Carbon Adsorption, Membrane Processes, supported liquid membrane, Emulsion Liquid membrane, UV treatment and other advanced treatment methods).Waste water of typical industries, sources, characteristics, effect and treatment option: textiles, refinery, leather, foods, sugar, fermentation, paper and pulp, fertilizer, soap and detergents, electroplating and pharmaceuticals.

Course Outcome	At the end of the course, the students will be able to: i) Understand the deep knowledge on instruments. ii) Understand the key points of various topic of chemistry starting from waste water treatment to instrumentation.
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Reference Books:

1. Industrial Effluents by Mani Vasakam, Shakti publ.
2. Industrial Pollution by VP Kudesia & RK Kudesia, Himalaya Publishing House
3. Introduction to Environmental Engineering and Science by Gilbert M. Masters, Pearson Education
4. Environmental Engineering and Safety by BK Nanda & T Biswal, BK publications
5. Environmental Engineering by SK Garg, Khanna Publication.
6. Mining Environment in India by SC Joshi et. al. Himalaya Research Publication.
7. Pollution Control and Management in Industries by Trivedi
8. Environmental Chemistry and Pollution Control by S. S. Dara, S Chand
9. Analytical Chemistry; Principle and Techniques by L. G. Hargis, Prentice Hall
10. Handbook of Analytical Instruments by R. S. Khandtur, Tata Mcgraw-Hill
11. Fundamentals of Molecular Spectroscopy by C. N. Banwell and E. M. Mc Cash, Tata McGraw Hill, 1994
12. Introduction to Spectroscopy by D.L. Pavia, G. M. Lampman, G. S. Kriz, Harcourt College Publisher, NY, 2001
13. Spectrometric Identifications of Organic Compounds by R. M. Silverstein, John Wiley, 1991.
14. Physical Chemistry by P. W. Atkins .

Paper Code	Paper Name	Credit	Int. Mark	Ext. Mark
CH-713	Research and Publication Ethics	2	20	30

Objectives	This course is based on philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course
Pre-Requisites	Knowledge on philosophy of chemistry and web browsing.
Teaching Scheme	Regular classroom lectures with use of chalk and black board. group discussions and practical sessions.

Unit-1: Philosophy and Ethics (3 hrs.)

Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: Definition, moral philosophy, nature of moral judgments and reactions.

Unit-II: Scientific conduct (5 hrs.)

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

Unit-III: Publication ethics (7 hrs.)

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. Violation of publication ethics, authorship and contributor ship, Identification of publication misconduct, complaints and appeals, predatory publishers and journals.

PRACTICE

Unit-IV: Open access publishing (4 hrs.)

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

Unit-V: Publication misconduct

A. Group Discussions (2hrs.):

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

B. Software tools (2 hrs.):

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

Unit-VI: Databases and Research metrics

A. Databases (4 hrs.):

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

B. Research Metrics (3 hrs.):

Impact Factor of journal as per Journal Citation report, SNIP, SJR, IPP, Cite Score.

Metrics: h-index, g-index, i10 index, altmetrics

Course Outcome	At the end of the course, the students will be able to: i) Known the knowledge of publication ethics. ii) Check the Plagiarism using various tools.
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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. Resnik, D.B. (2011). What is ethics in research and why is it important. National Institute of Environmental Health Science, 1-10.
<https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
5. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489 (7415) 179-179.
<https://doi.org/10.1038/489179a>
6. 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/Ethics_Book.pdf.

Paper Code	Paper Name	Credit	Int. Mark	Ext. Mark
CH-714	LITERATURE REVIEW	6	-	100

This is a project/ review type of work, has to be carried out by each student under direct supervision of faculty member(s) allotted against his/her name by the Department, that shall be notified by the Department in the due course of time and the report shall be submitted by the students during end term Examination.

Paper Code	Paper Name	Credit	Int. Mark	Ext. Mark
CH-715	PREPARATION OF RESEARCH PROPOSAL/ SYNOPSIS	4	-	50