North Lakhimpur University

Syllabus
Ph. D. Course Work (Physics)

Approved by the DRC, Physics Dept., NLU

March 2026

Ph. D. Course Work (Physics)

Duration: Two semesters

Total Credit: **18**

Course	Course Code	Course Name	Credits	Type	Marks	IA	ES
I	**CW-4-PHY-101**	Research Methodology	4	Theory	80	32	48
II	**CW-2-PHY-102**	Research and Publication Ethics	2	Theory+Practice	40	16	24
III	**CW-4-PHY-103**	Elective – I	3	Lab	60	24	36
IV	**CW-4-PHY-104**	(to be prepared by the Supervisor)	3	Theory	60	24	36
Total			12		240	96	144

Core Paper - I : Research Methodology

Paper Code: CW-4-PHY-101

Paper Type: Theory

Total Credit Hours: 30, Internal Marks: 16, End Sem Marks: 24

Unit I - Research methodology: Research concept, aims and objectives, motivation in research, criteria of good research, significance of research, problems encountered in research, Identification of research gap, Understanding the scientific questions, Novelty of research in support of existing literatures, setting hypothesis. **9**

Unit II - Steps in Research: Types of research, Research methods and methodology, review of literature-definition, functions and importance of literature review, procedures of review of literature and common weakness, results or findings, discussion- purpose and importance of good discussion, writing research proposal/synopsis. **9**

Unit III - Experimental designs: Formulation of research problem, sampling technique, methods selection, experimental set up, data generation/acquiring, Coding/decoding and reproducibility of data. **6**

Unit IV - Data collection, analysis and interpretation: Fundamentals of data collection, primary and secondary data, biological significance of data, methods of collecting data, sample and sampling methods, classification of data, tabulation and presentation of data. **7**

Unit V - Statistical analysis and data representation: SD, SE, Correlation and Regression, Test of significance, data validation, impact of small sampling size in data analysis, utility of computer/software (MS office, excel, power point, SPSS etc) in data analysis and presentation. **9**

Unit VI - Scientific writings: Forms of scientific writing *i.e.* research articles, notes, reports, review, monograph, dissertation/thesis, popular article, etc. Components of research article, Writing strategy for a research article. **8**

References:

1. C.R. Kothari – Research Methodology: Methods and Techniques, New Age International.
2. Ranjit Kumar – Research Methodology: A Step-by-Step Guide for Beginners, Sage Publications.
3. John W. Creswell – Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, Pearson.
4. Uma Sekaran and Roger Bougie – Research Methods for Business, Wiley.
5. Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams – The Craft of Research, University of Chicago Press.

Core Paper - II: Research and Publication Ethics

Paper Code: CW-2-PHY- 102

Paper Type: Theory + Laboratory

Total Credit Hours: 60, Internal Marks: 32, End Sem Marks: 48

Unit I - Philosophy and Ethics: Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and reactions. **4**

Unit II - Scientific Conduct: 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. **4**

Unit III - Publication Ethics: 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 behaviour and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publisher and journals. **4**

Unit IV - Open Access Publishing: 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 finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc. **4**

Unit V - Publication Misconduct: Group Discussion: a) Subject specific ethical issues, FFP, authorship b) Conflicts of interest c) Complaints and appeals: examples and fraud from India and abroad Software tools: Use of plagiarism software like Turnitin, Urkund and other open source software tools. **4**

Unit VI - Databases And Research Metrics: Databases: Indexing databases, Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per Journal Citations Report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 Index, altmetrics. **4**

(*Units 1,2 and 3 are to be covered via Theory mode and Units 4,5 and 6 are to be covered via practice mode)

References

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of
1. Research Integrity. 2007. Available at https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003

3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
7. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

Elective Paper - I: Research Techniques in Physics

Paper Code: CW-3-PHY- 103

Paper Type: Laboratory

Total Laboratory Hours: 90, Internal Marks: 24, End Sem Marks: 36

(Each research scholar shall choose any one group from the following list.)

Group A (High Energy Physics)

1. **Numerical Methods for High Energy Physics:**

   Mathematica and Python: Tensor algebra, Dirac gamma matrices, coupled differential equation, Boltzmann equation, scattering amplitudes and decay rates, plotting and fitting techniques.

2. **Model Verification Techniques:**

   Implementation of particle physics models in FeynRules, Generation of Feynman diagrams in CalcHEP, calculation of matrix elements

3. **Dark Matter Phenomenology and Event Simulation:**

   Relic density, direct detection cross-section calculation in MicrOMEGas, Event generation and LHC simulations in MagGraph and PYTHIA

Group B (Electronics and Photonics)

1. Electronic Circuit Design, PCB design and Fabrication Techniques.
2. Data Acquisition System Designing and interfacing.
3. Scientific Computing (optoelectronic and electronics devices) and Numerical Simulations. (COMSOL Multiphysics, Matlab, Opti-sytem, Python, Lumerical)
4. Semiconductor Fabrication Techniques.
5. Signal Processing Techniques.
6. Optoelectronic design fabrication.

Group C (Condensed Matter Physics)

Instrumentation and Characterisation Techniques in CMP

1. XRD (X-ray Diffraction)
2. UV-Vis Spectroscopy
3. DLS (Dynamic Light Scattering)
4. Raman Spectroscopy
5. SEM (Scanning Electron Microscopy)
6. TEM (Transmission Electron Microscopy)
7. AFM (Atomic Force Microscopy)
8. FTIR (Fourier Transform Infra-Red Microscopy)
9. STM (Scanning Tunnelling Microscopy)

Optional Paper - I

Paper Code: CW-3-PHY- 104

Paper Type: Laboratory

Total Class Hours: 45, Internal Marks: 24, End Sem Marks: 36

The syllabus for Optional Paper shall be framed by the respective Provisional Supervisor of the Research Scholar, based on the tentative research topic of the scholar. The paper may include both theoretical and laboratory components. The concerned supervisor shall set the question paper for the examination and evaluate the same. The Departmental Research Committee (DRC) shall conduct the examination, and the Chairman of the DRC shall submit the results to the Controller of Examinations (CoE).