

Research Methodology-II Course for Ph.D.

Research Methodology-II Course

S. No.	Course type	Course code	Course Title	Course Coordinator
1.	RM-II	26PHTXXX	Basic Tools for Research	Dr. Manoj Kumar

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF PHYSICS

Program: M.Sc. (Physics)

DETAILS OF THE COURSE

Course type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
RM-II	26PHTXXX	Basic Tools for Research	2	2	0	0	0

PREREQUISITE – A foundational understanding of statistical principles, and familiarity with undergraduate-level mathematical methods and computer is required.

COURSE OBJECTIVE(s)

The course aims to equip PG and Ph.D. students with essential skills for systematic scientific inquiry, covering ethical practices, literature surveying, and grant writing. It provides hands-on proficiency in professional documentation, alongside rigorous training in statistical error analysis and advanced data visualization and computational tools.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Research Methodology & Ethics

Introduction to Scientific Research: Meaning, Objectives, and Types, Literature Survey Strategies: Scopus, Web of Science, arXiv, and Google Scholar, Identifying the Research Gap: Problem Formulation and Objectives, Reference Management: Zotero and Mendeley, Research Ethics & Integrity: Plagiarism, IPR, and UGC-CARE/SCI Journals, Technical Communication: IMRaD Structure of Research Papers, Peer Review Process: Submission to Publication Workflow. Proposals Writing for funding.

(No. of lectures- 6)

Module II: Research Writing & Documentation Tools

LaTeX: Installation, TeXstudio, and Overleaf, Mathematical Typesetting: Equations, Symbols, and Matrices, Tables and Figures: Floating Environments and Cross-referencing, Bibliography Management: BibTeX and Automated Citations, Advanced LaTeX: Beamer for Posters and Presentations, MS Word for Thesis: Styles, Section Breaks, and Equation Editor, MS Excel for Scientists: Formulas, Logical Functions, and Data Organization, MS PowerPoint: Scientific Presentation and Layout Design, Vector Graphics: Inkscape and BioRender for Experimental Schematics.

(No. of lectures- 10)

Module III: Data Analysis & Software Tools

Theory of Errors: Systematic vs. Random Errors and Propagation. Statistical Distributions: Gaussian, Poisson, and Binomial. Curve Fitting: Linear/Non-linear Least Squares and Chi-square (χ^2) interpretation. Signal Processing: Noise Reduction and Fourier Transforms. OriginPro: Interface, Data Import, and 2D Plotting. Advanced Plotting: Multi-axis, 3D Surface, and Contour Mapping. Data Manipulation: Peak Analysis, Baseline Subtraction, and Integration. Automation: Analysis Templates and Batch Processing. Computational Tools: Python (NumPy/Matplotlib).

(No. of lectures- 10)

TEXT BOOKS: -

1. Kothari, C. R., & Garg, G., Research methodology: Methods and techniques (4th ed.) New Age International Publishers (2019)
2. The Theory of Errors in Physical Measurements by J C Pal, New Central Book Agency 2010.

REFERENCE BOOKS: -

1. Glasman-Deal, H., Science research writing for native and non-native speakers of English (2nd ed.) World Scientific Publishing (2021).
2. A Student's Guide to Data and Error Analysis by Herman J. C. Berendsen, Cambridge University Press (2011)
3. Goossens, M., Mittelbach, F., Rahtz, S., Roegel, D., & Voss, H., The LaTeX graphics companion (2nd ed.) Addison-Wesley Professional (2007)