

Raja Mahendra Pratap Singh University, Aligarh



Syllabus
Pre – Ph. D. Course Work
Physics

**(For both University Campus and Affiliated
Colleges of the University)**

(As per Guidelines of University Grants Commission)

(w.e.f. the session 2025-26)

Raja Mahendra Pratap Singh University, Aligarh

Ph.D. Course Work Syllabus

Paper – I: Research and Publication Ethics (RPE)

Credits: 2 Total Units: 4

Marks: 50

Course Type: Compulsory for all Ph.D. Scholars

Course Objectives

- To introduce research scholars to ethical principles in academic research.
- To develop awareness regarding publication ethics and research misconduct.
- To provide knowledge about plagiarism detection tools and citation practices.
- To familiarize scholars with quality research publications and indexing databases.

Unit I: Philosophy and Ethics of Research

- Meaning, objectives and significance of research
- Ethics in scientific research
- Moral philosophy: ethical theories and principles, values in research
- Scientific conduct: honesty, integrity, objectivity and transparency
- Ethical issues in research involving human participants, animals and environment

Unit II: Research Misconduct and Publication Ethics

- Definition and types of research misconduct: fabrication, falsification and plagiarism
- Redundant publications: duplicate publication and salami slicing
- Authorship ethics and criteria for authorship
- Responsibilities of authors, reviewers and editors
- Conflict of interest in research and publication

Unit III: Publication Practices and Journal Quality

- Types of research publications: research articles, review papers, conference papers, books and book chapters
- Quality parameters of journals: impact factor, citation index
- Indexing databases and platforms: Scopus, Web of Science, Google Scholar, DOAJ
- Predatory journals and publishers: Identification and prevention
- Open access publishing models

Unit IV: Plagiarism and Citation

- Meaning and types of plagiarism
- Academic integrity and plagiarism policies
- Plagiarism detection tools: Turnitin, Urkund

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Suggested Practical / Assignments

- Identification of predatory journals
- Demonstration of plagiarism checking using available software
- Preparation of reference list using reference management tools
- Writing a short research article with proper citation and referencing

Suggested Readings

1. Bird, A. (2006). Philosophy of Science. Routledge.
2. Resnik, D. B. (1998). The Ethics of Science: An Introduction. Routledge.
3. Shamoo, A. E., & Resnik, D. B. (2015). Responsible Conduct of Research. Oxford University Press.
4. National Academy of Sciences (2009). On Being a Scientist: A Guide to Responsible Conduct in Research.
5. Day, R. A., & Gastel, B. (2012). How to Write and Publish a Scientific Paper. Cambridge University Press.

Evaluation Scheme

Internal Assessment / Assignment / Seminar: 15 Marks

End Semester Examination: 35 Marks

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Raja Mahendra Pratap Singh University, Aligarh

Ph.D. Course Work Syllabus

Paper II: Research Methodology

Credits: 4 Units: 4

Total Teaching Hours: 60

Maximum Marks: 100

Course Objectives

- To develop a comprehensive understanding of research concepts and scientific inquiry.
- To familiarize scholars with different research designs and methodologies.
- To train scholars in techniques of data collection, analysis, and interpretation.
- To develop skills in academic writing, publication, and presentation of research findings.

Course Outcomes

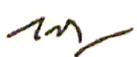
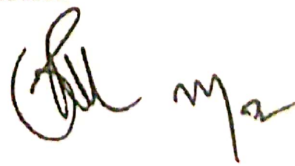
- Scholars will be able to identify and formulate research problems.
- Scholars will acquire knowledge of quantitative and qualitative research methods.
- Scholars will be able to analyze research data using statistical techniques.
- Scholars will develop the ability to write research papers and theses following academic standards.

Unit I: Foundations of Research

- Meaning, objectives and significance of research.
- Types of research: Basic, Applied, Descriptive, Analytical, Experimental and Exploratory research.
- Interdisciplinary and multidisciplinary research.
- Identification and formulation of research problem.
- Review of literature: Sources, methods and organization.
- Research design: Meaning, need and characteristics.

Unit II: Research Methods and Data Collection

- Quantitative and Qualitative research methods.
- Sampling: Concept, types and sampling techniques.
- Measurement and scaling techniques.
- Reliability and validity of research instruments.
- Use of secondary data and digital databases.

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Unit III: Data Analysis and Statistical Tools

- Data processing: Editing, coding, classification and tabulation.
- Descriptive statistics: Mean, median, mode and standard deviation.
- Correlation and regression analysis.
- Test methods: t-test, Chi-square test, ANOVA and WILCOX
- Graphical and diagrammatic representation of data.

Unit IV: Research Writing and Publication

- Structure of thesis/dissertation.
- Referencing styles: APA, MLA, Chicago, IEEE.
- Citation and bibliography preparation.
- Writing research papers for journals.
- Presentation of research findings and academic communication.
- Reference management tools: Mendeley, Zotero, and EndNote

Suggested Readings

- Kothari, C. R. - Research Methodology: Methods and Techniques.
- Kumar, Ranjit - Research Methodology: A Step-by-Step Guide for Beginners.
- Creswell, John W. - Research Design: Qualitative, Quantitative and Mixed Methods Approaches.
- Booth, Wayne C., Colomb, Gregory G., & Williams, Joseph M. - The Craft of Research.
- Gupta, S. P. - Statistical Methods.

Evaluation Scheme

Internal Assessment / Assignment / Seminar: 30 Marks

End Semester Examination: 70 Marks

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Ph.D. Course Work Syllabus

Paper-III: Subject Specific Course - Physics

Credits: 4

Units: 4

Maximum Marks: 100

Course Objectives

The objective of this course is to provide advanced knowledge of fundamental and modern areas of physics relevant to doctoral research. It aims to develop analytical, theoretical, and experimental skills necessary for conducting independent research in specialized areas of physics.

Unit I: Advanced Materials and Nanoscience

- Nanomaterials and low dimensional systems
- Quantum confinement and quantum dots
- Surface to volume ratio and its consequences
- Thin films and crystal growth techniques
- Characterization techniques: XRD, SEM, TEM, AFM
- Functional materials: piezoelectric, ferroelectric and multiferroic materials

Unit II: Experimental and Computational Techniques

- Experimental design and error analysis
- Vacuum techniques and cryogenic methods
- Optical spectroscopy techniques (UV-VIS spectroscopy)
- Electrical and magnetic measurements
- Data analysis using computational tools
- Introduction to simulation techniques in physics
- Scientific data presentation and Interpretation

Unit III: Experimental Techniques in nuclear physics

- Nuclear radiation detector: detecting mechanism, types of detectors, High - Purity Germanium (HPGe) detector.
- Accelerators: linear and cyclic accelerators, beam optics
- Pulse processing: timing and energy measurements
- CANDLE software, SRIM software, TRIM software, PACE software

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Unit IV: Elements of Astrophysics Research

- Motion and distance of stars,
- Telescope at different wavelengths
- Stellar atmosphere
- Cosmic rays, supernova, neutron star
- Newtonian and Einstein cosmology, H.R. Diagram, Geomagnetic storms

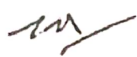
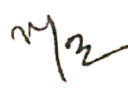
Suggested Readings

1. R. Shankar – Principles of Quantum Mechanics
2. Charles Kittel – Introduction to Solid State Physics
3. N. W. Ashcroft and N. D. Mermin – Solid State Physics
4. Guozhong Cao – Nanostructures and Nanomaterials
5. Yang Leng – Materials Characterization
6. Les Kirkup – Experimental Methods for Scientists and Engineers

Evaluation Scheme

Internal Assessment / Assignment / Seminar: 30 Marks

End Semester Examination: 70 Marks

Raja Mahendra Pratap Singh University, Aligarh

Ph.D. Course work syllabus

Paper – IV: Computer Application

Credits: 2 Units: 4

Maximum Marks: 50

Course Objectives

- To provide fundamental knowledge of computer to research scholars.
- To provide the knowledge of applications required for documentation and presentation.
- To provide the knowledge of digital tools used in literature survey and scientific writing.
- To provide the knowledge of Origin software

Unit – I: Fundamentals of Computer and Operating Systems

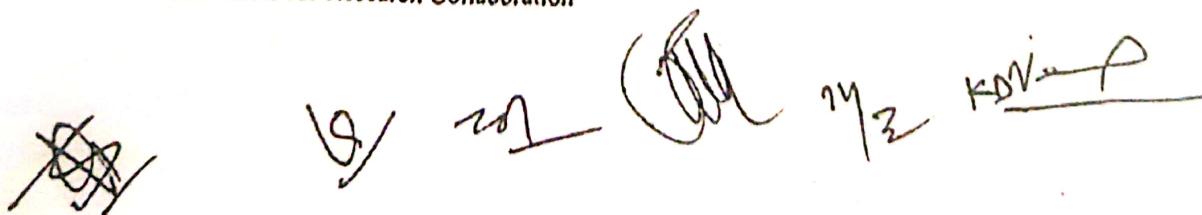
- Introduction to Computers: Components, Types and Applications
- Hardware and Software Concepts
- Operating Systems: Windows and Linux Basics
- File Management and Data Storage
- Computer Networks and Internet Basics
- Cyber Security Awareness and Safe Computing Practices

Unit – II: Office Applications for Academic Work

- Word Processing using MS Word / LibreOffice Writer
 - Formatting, Tables, Templates
 - Equation Editor and Symbols
 - References, Footnotes and Endnotes/Zotero
 - Preparation of Research Reports, Thesis and Articles using Word Processors
- Spreadsheet Applications using MS Excel / LibreOffice Calc
 - Data Entry and Management
 - Basic Statistical Functions
 - Graphs and Charts
- Presentation Tools using MS PowerPoint / LibreOffice Impress
 - Slide Design and Layout
 - Inserting Figures, Charts and Multimedia
 - Effective Academic Presentations

Unit – III: Computer Applications In Research

- Literature Search using Academic Databases
- Use of Digital Libraries and Online Resources
- Use of Internet Tools for Research Collaboration

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- Open Access Journals and Repositories
- Use of AI and Digital Tools in Academic Research
- Online Submission of Research Papers and Thesis
- Use of LaTeX for Scientific Documentation (Basic Introduction)

Unit – IV: Data processing using Origin

- Basics of origin-
 - Origin workspace, importing ASCII/Excel data, Data Connectors
 - 2D plotting, 3D plotting, customizing axes, legends, and themes for publication
 - creating templates for repetitive data analysis
 - statistical analysis.
- Peak fitting-
 - Finding baselines, peak detection, and peak integration
 - Non-linear Curve Fitting using Gaussian, Lorentzian, Voigt functions
 - Deconvolution or separating overlapping peaks in spectra
 - Outputting peak parameters (Area, Position, FWHM).

Suggested Readings

1. Peter Norton – *Introduction to Computers*
2. Alexis Leon & Mathews Leon – *Introduction to Computers*
3. V. Rajaraman – *Fundamentals of Computers*
4. Kogent Learning – *Office 365 / Microsoft Office Step by Step*
5. Wayne Winston – *Microsoft Excel Data Analysis and Business Modeling*
6. Leslie Lamport – *LaTeX: A Document Preparation System*
7. S.P. Gupta – *Statistical Methods* (for basic data analysis)
8. University Grants Commission – *Research and Publication Ethics Guidelines*

Evaluation Scheme

Internal Assessment / Assignment / Seminar: 15 Marks

End Semester Examination: 35 Marks

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