

GURU KASHI UNIVERSITY



Doctor of Philosophy

Session: 2025-26

Department of Physics

**Faculty of Sciences, Humanities and
Languages**

Program Structure										
Sr. No	Course Code	Course Title	Course Type	L	T	P	Credits	Internal	External	Total Marks
1	PPH101	Research Methodology	Core	4	0	0	4	30	70	100
2	PPH102	Research and Publication Ethics	Core	2	0	0	2	30	70	100
3	PPH126	Recent Advances in Physics	Core	4	0	0	4	30	70	100
4	PPH104	Computer Applications in Research	Skill Based	0	0	4	2	30	70	100
Total				10	0	4	12	120	280	400

Course Title: Research Methodology**Course Code: PPH101**

L	T	P	Credits
4	0	0	4

Total Hours: 60**Learning Outcomes****On the completion of the course the students will be able to**

1. Formulate research problems by conducting comprehensive literature reviews utilizing web sources
2. Apply appropriate research design choices based on research questions and objectives.
3. Explore the integration of qualitative and quantitative data and the concept of triangulation and complementarity of data sources.
4. Utilize statistical software packages commonly used in research for importing, managing, cleaning, and analyzing data.
5. Apply different statistical techniques to summarize and analyze data effectively.

Course Content**Unit-I****15 Hours****Introduction to Research**

Meaning, Objectives, Characteristics, Significance and Types of Research.

Understanding a Research Problem, Literature Review, Methods and Reporting, Selecting the Research Problem, Steps in Formulation of a Research Problem,

Unit-II**15 Hours****Research Process and Hypothesis**

Constructing Hypotheses; Conceptualizing a Research Design-Meaning and Types of Research Design.

Parametric and Non-Parametric Test, Errors and Level of Significance.

Completely randomized design, Random block design, Latin square design, Statistical analysis.

Components of time series, Analysis of time series, Measurement of trend, Measurement of seasonal variations.

Unit-III**15 Hours****Sampling Design and Data Analysis**

Sampling Techniques-Probability and Non-Probability, Qualities of a good Sample, Sample Size and its Determination. Introduction to Qualitative, Quantitative and Mixed Methods, Quantitative Methods- Univariate, Bivariate and Multivariate, Qualitative Methods-Grounded Theory and Triangulations, Mixed Methods- Convergent Parallel, Explanatory Sequential, Exploratory Sequential and Transformative.

Implementation of statistical techniques using statistical packages viz. SPSS R including evaluation of statistical parameters and data interpretation, Regression Analysis, Covariance, analysis of variance.

Unit-IV

15 Hours

Report Writing

Types of Reports- technical and Popular Reports, Significance of Report Writing, Different Steps in Writing Report, Art of Writing Research Proposals, Research Papers, Projects Reports and Thesis; Basics of Citation and Bibliography/Reference Preparation Styles; Report Presentation: Oral and Poster Presentations of Research Reports.

Suggested Reading

1. Gupta, S. (2010). *Research Methodology and Statistical Techniques*. Deep & Deep Publications (P) Limited, New Delhi.
2. Kothari, C.R., Garg, G. (2019). *Research Methodology: Methods and Techniques*. 4th Edition, New Age International (p) Limited. New Delhi.
3. Sahay, Vinaya and Pradumna Singh (2009). *Encyclopedia of Research Methodology in Life Sciences*. Anmol Publications. New Delhi.
4. Kauda J. (2012). *Research Methodology: A Project Guide for University Students*. Samfunds literature Publications.
5. Dharmapalan B. (2012). *Scientific Research Methodology*. Narosa Publishing

L	T	P	Credits

Course Title: Research and Publication Ethics

Course Code: PPH102

2	0	0	2
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Total Hours 30**Learning Outcomes****On the completion of the course the students will be able to**

1. To have awareness about the publication ethics and publication misconducts.
2. To understand indexing and citation databases, open access publications, research metrics (citations, h-index, impact factor etc)
3. Develop hands-on skills to identify research misconduct and predatory publications.

Course Content

- **RPE 01: PHILOSOPHY AND ETHICS** **(3 Hrs.)**
 1. Introduction to philosophy: definition, nature and scope, concept, branches
 2. Ethics: definition, moral philosophy, nature of moral judgements and reactions
- **RPE 02: SCIENTIFIC CONDUCT** **(5 Hrs.)**
 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
- **RPE 03: PUBLICATION ETHICS** **(7 Hrs.)**
 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 behavior 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
- PRACTICE**
- **RPE 04: OPEN ACCESS PUBLISHING** **(4 Hrs.)**
 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.
- **RPE 05: PUBLICATION MISCONDUCT** **(4 Hrs.)**

A. Group Discussions (2 hrs.)

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 (2 hrs.)

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

• **RPE 06: DATABASES AND RESEARCH METRICS (7 Hrs.)**

A. Databases (4 hrs.)

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

B. Research Metrics (3 hrs.)

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

Suggested Readings

1. Bird, A. (2006). *Philosophy of Science*. Routledge.
2. MacIntyre, A. (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. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.
5. Rensik, D. B. (2011). *What is ethics in research & why is it important*. National Institute of Environmental Health Sciences, 1-10. Retrieved from <https://www.niehs.nih.gov/resources/bioethics/whatis/index.cfm>
6. Beall, J. (2012). *Predatory publishers are corrupting open access*. *Nature*, 489(7415), 179-179. <https://doi.org/10.1038/489179a>

Course Title: Research Advances in Physics**Course Code: PPH126**

L	T	P	Credits
4	0	0	0

Total Hours 60**Learning Outcomes****On the completion of the course the students will be able to**

1. Apply perturbation methods, variational techniques, and relativistic quantum theories to solve advanced quantum mechanical problems.
2. Analyze the electronic, magnetic, and superconducting properties of materials, including nanostructures.
3. Explain the interaction of radiation with matter, operate and calibrate radiation detectors, and evaluate applications in medical diagnostics, treatment, and radiation safety.
4. Demonstrate an understanding of cutting-edge developments in physics and their interdisciplinary applications in environment, energy, and healthcare.

Unit I**15 Hours**

Advanced Theoretical Physics: Time-dependent and time-independent perturbation theory. Variational principle and WKB approximation. Partial wave analysis and Born approximation. Klein-Gordon and Dirac equations. Quantum field theory basics: Path integrals and second quantization. Micro canonical, canonical, and grand canonical ensembles, Landau theory and critical phenomena. Dissipation theorem and correlation functions. Transport theory and Boltzmann equation.

Unit II**15 Hours**

Condensed Matter Physics: Metals, semiconductors, and insulators, density of states and Fermi surfaces, Quantum Hall effects and topological insulators. Magnetic Properties of Materials. Giant magnetoresistance and tunneling magnetoresistance. Spin waves and magnons in magnetic materials. BCS theory of superconductivity. Synthesis methods of nanomaterials: Chemical vapor deposition, sol-gel processes, and molecular beam epitaxy. Properties of nanostructures.

Unit III**15 Hours**

Radiation Physics: Interaction of radiation with matter, Alpha, beta, and gamma decay, with applications in energy and diagnostics. Gas ionization chambers, scintillation detectors, semiconductor detectors, calibration of detectors, energy and flux measurements, X-rays, CT scans, PET, radiotherapy, brachytherapy, non-destructive testing, radiation

sterilization, dosimetry, radiation monitoring, cosmic radiation, ALARA principles, shielding materials, regulatory standards.

Unit IV

15 Hours

Emerging Trends in Physics: Quantum computing and quantum cryptography. 2D materials (graphene, transition metal dichalcogenides) and topological insulators. Biophysics and medical imaging techniques. Climate modeling, renewable energy, and atmospheric studies. LHC, neutrino observatories, and dark matter searches. Recent advancements in understanding dark energy and gravitational waves. Precision measurements in spectroscopy and interferometry.

Suggested Readings:

- Zettili, N. (2009). *Quantum mechanics: Concepts and applications*. Wiley.
- Huang, K. (1987). *Statistical mechanics* (2nd ed.). Wiley.
- Chaikin, P. M., & Lubensky, T. C. (1995). *Principles of condensed matter physics*. Cambridge University Press.
- Zhang, Y., & Li, X. (2017). *Physics of nanomaterials and nanodevices*. Springer.
- Saha, G. B. (2019). *Physics and radiobiology of nuclear medicine* (4th ed.). Springer.
- Sierk, A. J. (2018). *Introduction to radiation protection: A guide for medical and health professionals* (2nd ed.). CRC Press.

Course Title: Computer Applications in Research**Course Code: PPH104**

L	T	P	Credits
0	0	4	2

Total Hours 30**Learning Outcomes****On the completion of the course the students will be able to**

1. The students will become familiar with the usage of software for managing the reference.
2. To make literature reviews easily.
3. To make reference management by using open software.

Couse Content**Unit-I****06 Hours**

MS Word Essentials- Create a document with styled headings and subheadings, Add headers, footers, and page numbers, Adjust page layout settings (margins, orientation, page size).

Table Creation and Management- Insert, format, and style tables, Adjust cell size, merge/split cells, and sort/filter data.

Working with Graphics- Insert and format images, shapes, SmartArt, and text boxes, Apply text wrapping around objects.

Unit-II**08 Hours**

Basics of PowerPoint- Slide layouts, themes, and templates, Adding multimedia: Images, audio, and videos.

Advanced Techniques- Animations and transitions for visual effects, Slide master for consistent formatting, Interactive elements: Hyperlinks and action buttons.

Design Best Practices- Typography, color schemes, and visual hierarchy, Tips for engaging presentations.

Unit-III**08 Hours**

Introduction to Mendeley- Installing and setting up Mendeley Desktop and Web, Importing references from various sources.

Organizing References- Creating folders and tagging references, Annotating and highlighting PDFs.

Citations and Bibliography- Integrating Mendeley with MS Word, using citation styles (APA, MLA, Chicago), Generating a bibliography automatically.

Unit-IV**08 Hours**

AI Tools for Productivity- Text-Based AI Tools (e.g., ChatGPT) Writing assistance, summarization, and brainstorming, Grammar and style checking, Image and Design Tools, Speech and Audio Tools

Suggested Readings

- 1) Office 2007 in Simple Steps, Kogent Solutions, (Wiley Publishers).
- 2) MS-Office 2007 Training Guide, S. Jain (BPB Publications).
- 3) Computer Fundamentals by P.K. Sinha (BPB Publications).
- 4) <https://www.mendeley.com/reference-management/reference-manager>
- 5) <https://chat.openai.com>

- 6) <https://edu.google.com/workspace-for-education/classroom/>

