

**ACADEMIC CURRICULUM**  
**Pre-Ph.D. (Physics): 14 Credits**

Name of the Programme : ~~Ph.D.~~ Ph.D. Course work in Physics  
Duration : Six Months

The Scheme for ~~Ph.D.~~ Ph.D. course work for 2023-24 is as under:

Course Code	Name of the Course	Credit
PPD - 101	Research Methodology	04
PPD - 102**	Review of Literature and Seminar (in Relevant Research Area)	04
PPD - 103*	Departmental – Elective Course	04

**\*Anyone of the following:**

PPD-103(i) Laser & Photonics

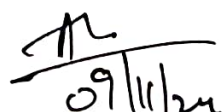
PPD-103(ii) Analytical/Fabrication Technique

PPD-103(iii) Physics of Materials


PPD-103(iv) Properties of Materials

PPD-104 Research and Publications Ethics (RPE) 02

**\*\*For course work PPD-102 , Review of Literature and seminar (In Relevant Research Area) Ph. D Ordinance is followed by the Department.**

  
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Department of Physics  
Guru Jambheshwar University  
of Sc. & Tech., Hisar-125001

**Paper- 1**  
**Research Methodology**  
**(Science Discipline)**  
**PPD 101**

  
M. Marks: 100  
CREDITS: 4  
Time: 3 Hours

Paper setter is required to set nine questions in all. Question no. 1 is Compulsory and is based on the entire syllabus consisting of five short answer type questions each of 2 marks. The remaining eight questions is to be set uniformly having two questions from each unit. The student is required to attempt five questions in all selecting one question from each unit and Question no. 1 is Compulsory.

Course Objective	Course Outcome
The course on the Research Methodology deals with the research problem, writing of thesis, computer application in research and presentation.	The student will be able to understand how to frame the objectives of research problem using various tools and finally the presentation.

**Unit -I**

**Introduction to Research Methodology:** Meaning, Objectives, Types and Significance of research, Creativity and Innovation, Hypothesis formulation and development of Research plan.

**Research Problem:** Definition, necessity and techniques of defining the research problem.

**Library:** Classification system, e-library, Reference management, Web based literature search engines.

**Use of modern aids:** Making technical presentation, Research and academic integrity: Avoiding Plagiarism using software. Copy right issues, ethics in research, Intellectual Property Rights (IPRs) & patent Law.

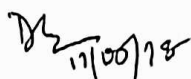
**Unit -II**


**Scientific Communications:** Role and importance of communications, Effective oral and Written Communication, Scientific and Research paper writing, Technical report writing. Making Research & Development (R&D) proposals.

**Publishing Research paper:** Selection of journal, formulation of problem, discussion and references, Submission and handling of reviewers comments.

**Writing of thesis:** Format of thesis, Review of literature, Formulation: Writing methods result, preparation of tables, figures; writing discussion: writing conclusion; Writing summary and synopsis; Reference citing and listing/ Bibliography.

**Laboratory safety issues:** Related to various labs, Workshop, electrical, health and fire safety, safe disposal of hazardous materials.

  
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### Unit-III

**Statistical analysis and errors:** Mean, Mode, Median, Relative and absolute errors, Hypothesis testing for mean, proportion and variance, Chi-square tests, Correlation and regression analysis, Factor analysis.  
Linear and non-linear least squares fitting methods, Interpolation methods including cubic splines, Fourier Series Analysis, Fast Fourier Transform, Convolution and Correlation.

### Unit-IV

**Computational tools and Programming:** Resume of Practical approach of learning operating systems (DOS, Windows, UNIX), Graphical packages, Calculations using Spreadsheet programming. Technical research paper writing in Latex. Introduction to HTML, XML & programming languages, an overview of Modeling and simulation software's,

**Online Resources:** Introduction to Massive Open Online Courses (MOOCs) and Study Webs of Active -Learning for Young Aspiring Minds (SWAYAM), Indexing and abstracting services, Citation index and impact factor, Research quality parameters and indicators

#### References:

1. Gurumani, N.(2010), Scientific thesis writing and Paper presentation, MJP publishers.
2. Gerald, C.F. and Wheatley, P.O. (2002) Applied numerical analysis, 6<sup>th</sup> Ed , Addison Wesley.
3. Smith G.D. , (1982) Numerical solution of partial differential equation, Oxford University Press.
4. Schwartz H.R., Rutishauser H. Stiefel E. et al (1976) Numerical analysis of symmetric matrices, Prentice Hall
5. C.R. Kothari & Gaurav Garg (2014), Research Methodology, Third Edition, New Age International Publishers.
6. Web resources: [www.sciencedirect.com](http://www.sciencedirect.com) for journal references, [www.aip.org](http://www.aip.org) and [www.aps.org](http://www.aps.org) for references styles.
7. Web Resources: [www.nature.com](http://www.nature.com) , [www.sciencemag.org](http://www.sciencemag.org), [www.springer.com](http://www.springer.com), [www.pnas.org](http://www.pnas.org), [www.tandf.co.uk](http://www.tandf.co.uk), [www.opticsinfobase.org](http://www.opticsinfobase.org) for research updates.

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**PPD-103(i)**

**Laser & Photonics**

**M. M. :100**

**Credits: 4**

**Time: 3 Hours**

**Paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. Rest of eight questions is to be set uniformly selecting two questions from each unit. Students are required to attempt five questions in all selecting one from each unit and a compulsory question**

**Unit I:**

Ruby Laser, ND:YAG Laser and Nd:Glass Lasers Er-doped silica fiber laser, Ti-sapphire Laser, CO<sub>2</sub> and Ar-ion lasers, excimer and dye lasers

**Unit II:**

Semiconductor lasers: Double heterostructure and quantum-well lasers, VCSEL DFB and DBR lasers, Applications of lasers, Communication and Defense,

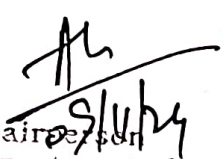
**Unit III:**

Adaptive Optics, Laser Spectroscopy and Instrumentation, LIDAR, Holography and Speckle imaging. Optical sources for transmission, Transmitter design, Receiver design and Performance,

**Unit IV:**

System design and performance, Multi-channel light wave systems, System performance issues, Optical amplifiers, Dispersion Soliton Transmission.

**References:** 1. Quantum Electronics by Verdeyan  
2. Optical Electronics by A.K. Ghatak

  
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PPD- 103 (ii)

Analytical/ Fabrication Techniques

M. M :100

Credits :4

Time: 3 Hours

Paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. Rest of eight questions is to be set uniformly selecting two questions from each unit. Students are required to attempt five questions in all selecting one from each unit and a compulsory question

**Unit I**

Thermal analysis; Thermogravimetric Analysis, Differential Thermal Analysis and Differential Scanning Calorimetric, Magnetometry; Techniques to measure Magnetic Domain Structures, Photoluminescence spectroscopy, Ultraviolet and Visible Absorption Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Electron Paramagnetic Resonance Spectroscopy, Mossbauer Spectroscopy.

**Unit II**

X-Ray Powder Diffraction, single-crystal X-Ray Structure Determination, XAFS Spectroscopy. X-Ray Photoelectron Spectroscopy, Neutron Powder Diffraction, Magnetic Neutron Scattering, Scanning Electron Microscopy, Scanning Tunnelling Microscopy, Low Energy.. Electron Diffraction, Energy Dispersive Spectroscopy, Auger Electron Spectroscopy. C

**Unit III**

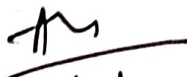
Physical Vapour Deposition: PVD processes, Theory and Mechanism, Evaporation process and Apparatus, Evaporation sources, Pulsed Laser Deposition, Sputter Deposition Processes Sputtering mechanism, Sputter deposition Techniques, Vacuum System.

**Unit-IV**

Chemical vapour deposition: Design of CVD experiments, Gas Flow dynamics, Plasma Enhanced CVD, Deposition from aqueous solutions: electrodeposition, Sol-gel and LB deposition.

References:

- a) Characterization of materials by E.N. Kaufmann
- b) Handbook of Deposition Technologies for Film and Coating by R.F.Bunshah

  
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**PPD-103(iii)**  
**Physics of Materials**

M. M :100

Credits: 4  
Time : 3 Hours

Paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. Rest of eight questions is to be set uniformly selecting two questions from each unit. Students are required to attempt five questions in all selecting one from each unit and a compulsory question.

**Unit I**

Types of Amorphous Solids, Aspects of Glass Transition, Structure, rep and crn Structure, EXAFS, Molecular Solids and Network dimensionality, Electronic Structure of Amorphous Solids, Localized and extended States, Mobility Edges

**Unit II**

CFO Model, Density of States and their Determination, Transport in extended and localized States, Applications of important Amorphous Materials, Hydrogenated Amorphous Silicon, Chalcogenide Glasses, Metallic Glasses, Oxide Glasses.

**Unit III**

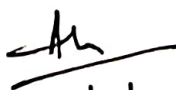
Bonding in Ceramics and their structure including defects and non-stoichiometry; Development of Microstructure in Equilibrium and non-equilibrium phases, Calcinations, Grain growth and Solid liquid phase sintering.

**Unit IV**

Physics of low-dimensional materials, 1D, 2D and 3D confinement, Density of states, Excitons, Coulomb blockade, Surface Plasmon, Size and surface dependence of various properties.

References:

1. Material Science by J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rawlings'
2. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
3. Solid State Physics by Mermin and Ashcroft.

  
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**PPD-103(iv)**

**Properties of Materials**

**M. M :100**

**Credits :4  
Time: 3 Hours**

Paper setter is to set nine questions in all. Question no. 1 (compulsory based on the entire syllabus) will consist of five short answer type questions, each of two marks. Rest of eight questions is to be set uniformly selecting two questions from each unit. Students are required to attempt five questions in all selecting one from each unit and a compulsory question.

**Unit I**

Drude and Sommerfeld theories of metals, Effect of periodic lattice potential, Magnetic behavior-exchange interaction and magnetic domains,

**Unit II:**

Ferromagnetic order, single domain magnets, spin waves, surface magnetism, dielectric constants of solids and liquids, Clausius- Mossoti relation, dielectric dispersion and losses, piezo, ferro- and pyroelectricity


**Unit III**

Optical constants, atomistic theory of optical properties, quantum mechanical treatment, band transitions, dispersion.

**Unit IV**

Optical properties of amorphous semiconductors, absorption edge and absorption tail, high absorption region, Photonic Materials and their properties.

1. Material Science by J. C. Anderson, K. D. Leaver, J. M. Alexander and R. D. Rawlings'
2. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
3. Solid State Physics by Mermin and Ashcroft.

  
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PPD-104

Credit = 2  
M.M. = 100

~~LECTURE~~  
Time = 3 Hrs.

**Course Title:**

- Research and Publication Ethics (RPE)-Course for awareness about the publication ethics and publication misconducts.

**Course Level:**

- 2 Credit course (30 hrs.)

**Eligibility:**

- M.Phil., Ph.D. students and interested faculty members (It will be made available to post graduate students at later date)

**Fees:**

- As per University Rules

**Faculty:**

- Interdisciplinary Studies

**Qualifications of faculty members of the course:**

- Ph.D. in relevant subject areas having more than 10 years' of teaching experience

**About the course**

**Course Code: CPE- RPE**

**Overview**

- This course has total 6 units focusing on basics of 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.

**Pedagogy:**

- Class room teaching, guest lectures, group discussions, and practical sessions.

**Evaluation**

- Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.

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## Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
<b>Theory</b>		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
<b>Practice</b>		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	<b>Total</b>	<b>30</b>

## Syllabus in detail

### THEORY

- RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**
  - Introduction to philosophy: definition, nature and scope, concept, branches
  - Ethics: definition, moral philosophy, nature of moral judgements and reactions
- RPE 02: SCIENTIFIC CONDUCT (5hrs.)**
  - 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
- RPE 03: 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 contributorship
  - Identification of publication misconduct, complaints and appeals
  - 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 Suggester, etc.
- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**
    - 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 (7hrs.)**
    - 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

## References

- Bird, A. (2006). *Philosophy of Science*. Routledge.
- MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.
- P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865
- 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.
- Resnik, 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/research/resources/bioethics/whatis/index.cfm>
- Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>
- 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](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)

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