

## Syllabus

## Ph.D. Course Work

PHYSICS

**Syllabus for Ph.D. Course Work inPhysics (2020-21)**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Name of Subject** | **Credits** |
| **1.** | **Review of related literature** | **03** |
| **2.** | **Research Methodology** | **04** |
| **3.** | **Computer applications** | **03** |
| **4.** | **Subject Specific-I** | **03** |
| **5.** | **Research and publication ethics** | **02** |
| **6.** | **Comprehensive viva Voce** | **03** |
|  | **Total Credits** | **18** |

**Paper I: Review of related literature Credits: 03**

1.Selection of topic for literature.

2.Chronological development of the topic.

3.Current trends and Future scope.

**Paper II: Research Methodology Credits:04**

**Unit I- Structural studies** 11Lectures

Basic Materials Characterization Techniques: Principle, instrumentation and applications of the following techniques- X ray based techniques: X-ray diffraction (XRD) and X-ray absorption fine structure (XAFS), Optical Spectroscopy: UV-VIS and FTIR Spectroscopy, Photoelectron spectroscopy: X-ray photoelectron spectroscopy.

**Unit II Electrical measurements** 11Lectures

Transport measurements: Metal, Superconductors, Insulators and Semiconductors, Four probe and Van der Pauw techniques, Magnetoresistance, Hall measurements, Thermoelectric power, Thermal conductivity, Differential scanning calorimetry, Dielectric measurement.

**Unit III Magnetic measurements** 11Lectures

Magnetic and structural characterization using - Mössbauer spectroscopy, magnetic hysteresis measurements making use of conventional induction technique and vibrating sample magnetometer technique, determination of magnetic anisotropy using torque magnetometer and, magnetostriction measurements using stress dependence of hysteresis loop and small angle magnetization rotation method.

**Unit IV Mathematical Techniques.** 11Lectures

Integral transforms. Fourier transform and inverse Fourier transforms. Convolution theorem. Laplace transforms. Laplace transforms of derivatives. Solving differential equations using Laplace transform technique.

Green’s functions and solution of Non-homogenous boundary value problems.

Complex analysis: Cauchy Riemann equations, Cauchy integral theorem and formula. Taylor’s and Laurent series. Residue Theorem and contour integration.

**Books Recommended:**

1. Mathematical Methods for Physicists: G. B. Arfken
2. Complex Variables, M R Spiegel, Schaum’s Outline Series.
3. Laplace Transforms, M R Spiegel, Schaum’s Outline Series.

**Paper III: Computer Applications Credits: 03**

**35Lectures**

**Unit I**

Programming using C++.Numeric data type expression input /output, logical expression, selection control structure, loops, if, for, while and do-while.

**Unit II**

A. Matlab / Scilab.The basic features of Matlab / Scilab, viz., variables, function & arrays, scripts, and operations. Visualization, programming, interpolation and integration.

B. Microsoft Excel /OpenOffice Calc The basic features of spreadsheets, arithmetic operations on grid cells, inbuilt mathematical and statistical functions, display of data as line graphs, histograms and charts. Applications in using numerical methods.

**Unit III**

Application of various software’s including-graphics software, such origin etc. Data analysis software’s and their application in research, linear and polynomial regression.

**Books Recommended:**

1. Turbo C++, Robert Lafore, Galgotia Publications Pvt. Ltd, ISBN 81-85623-22-8.
2. Programming and Problem Solving with C++, N. Dale and C. Weems, Jones and Bartlett Publication, ISBN 978-93-80108-50-6.
3. Numerical mathematical analysis: J. B. Scarborough.
4. First course in numerical analysis: A Raltson.
5. Numerical methods in Science and Engg: S Rajsekharan.
6. Numerical methods for Physics, Science and Engineering: J. H. Mathews, Tata McGraw Hill Publishers 1984.
7. Numerical Methods for Engineers, Steven C. Chapra and Raymond P. Canale, McGraw-Hill Book Company, ISBN-0-07-100412
8. Matlab by Rudra Pratap.

**Subject Specific- I Laser Applications: Credits: 03**

**35Lectures**

**Unit I: Laser application in fiber-optical communication and free electron laser**

Introduction to waveguide: theory of electromagnetic waves in parallel plate and rectangular metal waveguide-concept of modes-Poynting vector calculation, optical fiber

Propagation, Electromagnetic analysis of simple optical waveguide. Testing of fiber optic systems: attenuation, Numerical aperture, optical power, power measurement, fiber sensor

Free electron laser : introductory idea about undulator and small signal theory of free electron laser gain

**Unit II: Laser application in plasma**

Two-fluid description of plasmas. Plasma Oscillations, Electron Plasma wave and Ion Wave. Electromagnetic wave propagation in plasmas, propagation of obliquely incident light waves in inhomogeneous plasmas.

**Unit III: Laser application in photonics**

Photonic crystals and resonators, Photonic bandgap, Defects in photonic crystals, Surface plasmons, Surface plasmons in noble metals, Surface plasmon polaritons at plane interfaces.

**Books Recommended:**

1. Photonic Crystals: Physics, Fabrication & Applications, K. Inoue & K. Ohtaka (Eds.), Springer-Verlag Berlin Heidelberg New York, 2004.
2. Practical fiber optics by bailey and wright, An imprint of Elsevier, Jordan Hill, Oxford in 2003.
3. G.Dattoli,L.Giannessi,M.Richeta,A.Torre,Phys.Rev.A, Vol. 45, (1992), 4023.
4. Y. Li, B. Faatz and J. Pflueger, Magnet sorting for the XFEL hybrid undulator comparative study, DESY Report, TESLA-FEL, August 2007.
5. Lectures on the Free Electron Laser Theory and Related Topics, by G. Dattoli.
6. Introduction to Plasma Physics and Controlled Fusion: F. F. Chen
7. Introduction to Plasma Theory: D.R. Nicholson
8. Laser Plasma Interaction by Willian L. Kruer, Addison-Wesley Publishing Company.

**Research and publication ethics Credits: 02**

22Lectures

**THEORY**

PHILOSOPHY AND ETHICS: Introduction to philosophy- definition, nature and scope, concept, branches. Ethics- definition, moral philosophy, nature of moral judgements and reactions

SCIENTIFIC CONDUCT: Ethics with respect to science and research, Intellectual honesty and research integrity, Scientific misconducts -Falsification, Fabrication, and Plagiarism, Redundant publications- duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data.

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**

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 finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

PUBLICATION MISCONDUCT

Group Discussions on Subject specific ethical issues, FFP, authorship. Conflicts of interest

Complaints and appeals: examples and fraud from India and abroad.

Software tools: Use of plagiarism software like Tumitin, Urkund and other open source software tools.

DATABASES AND RESEARCH METRICS

Databases: Indexing databases. Citation databases: Web of Science, Scopus, etc.

Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score. 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 EditfOn.* 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 [httos://www.nieiys.nih](http://www.nieiys.nih.ov/research/resources/bioethics/whatis/index.cfm).g[ov/research/resources/bioethics/whatis/index.cfm](http://www.nieiys.nih.ov/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.insaindiares.in/pdf/EthicsBook.pdf)