



School of Physics

Devi Ahilya Vishwavidyalaya

Vigyan Bhavan, Khandwa Road Campus,

Indore-452001, M. P. INDIA

Syllabus

Ph.D. Course Work

PHYSICS

2023-2024

Head

Prof. & Head
School of Physics
Devi Ahilya Vishwavidyalaya
Khandwa Road, INDORE-452017

**Syllabus for Ph.D. Course Work
in Physics (2023-24)**

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

15Lectures

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

15Lectures

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

15Lectures

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.

Books Recommended:

1. C. Kittel, "Introduction to Solid State Physics" Wiley Eastern Ltd, 2005. 4.
2. A.J. Dekker, "Solid State Physics", Macmillan & Co, 2000.
3. Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, CRC Press, (2008)
4. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley & Sons (2008)
5. Elton N. Kaufmann, Characterization of Materials, Vol.1, Wiley & Sons (2003)
6. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley & Sons, 2007.
7. Michael Shur, "Physics of Semiconductor Devices", Prentice Hall of India, 1995.
8. Charles P Poole Jr., and Frank J. Ownes, Introduction to Nanotechnology, John Wiley Sons, Inc., 2003
9. V.R.Gowariker, "Polymer science ",New age international Publishers, 1986

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.

Paper IV: Subject Specific- I

Credits:03

35Lectures

Chose any one stream.

Stream A

Advanced characterization techniques

Stream B

Electromagnetics, plasmas and Laser Applications

Stream A

ADVANCED CHARACTERIZATION TECHNIQUES :

X-ray diffraction. Diffraction under non-ideal conditions. Atomic scattering and Geometrical structure factors. Factors influencing the intensities of diffracted beams. Powder X-ray diffractometer. Applications of XRD in ceramic materials.

Study of the morphology, aggregation, size and microstructure of ceramic materials using. Optical microscope, quantitative phase analysis. Principle of electron microscopy.

Atomic Force Microscope. Mechanism of image formation in SEM and its processing. Electron microprobe analysis (EDAX and WDS). Preparation of samples for electron microscopic studies. ESCA and PES.

Spectrophotometric analysis of materials: Basic laws of spectrophotometry and its application in micro analysis in UV/ Visible range, effect of reflectance factor on optical analysis, construction and working principle of spectrophotometer, importance of additive absorbances in multiple analysis of materials. Infrared spectrophotometry: General aspects of IR spectroscopy and its application in structural analysis of systems, sources of IR radiations, Optical systems and operation of FTIR spectrophotometers. Samples preparation, IR analysis and structural correlations.

REFERENCES:

1. Sam Zhang, Lin Li and Ashok Kumar, Materials Characterization Techniques, CRC Press, (2008)
2. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, Wiley & Sons (2008)
3. Elton N. Kaufmann, Characterization of Materials, Vol.1, Wiley & Sons (2003)

Stream B

Electromagnetics of plasmas and Lasers.

Unit I: Introduction to Electromagnetics

Electromagnetic waves: E. M. waves in vacuum, polarization, Poynting vector, refraction and reflection of EM waves at interface between two dielectrics.

Boundary value problems in presence of metallic interface: reflection and refraction from metallic surface, waveguides and resonator.

Unit II: Introduction to Lasers and Laser application

Special laser characteristics: Brightness, coherence and directionality, Laser amplification and Oscillations, three level and four level lasers, optical resonators ,laser rate equations and specific laser systems. Laser applications .

Unit III: Introduction to plasma physics

Plasma Parameter, Debye Shielding, Plasma Oscillations, Single Particle Motion- Adiabatic Constants, Trapping in Mirrors, Plasma Models- Kinetic Descriptions, Two Fluid Equations, Waves and Instabilities- Electro-magnetic Waves, Alfven Waves, Ion Acoustic Waves, Kinetic Treatment of Waves, Landau Damping.

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.

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 Turnitin, 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 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](#)