Pre-Ph.D. Course Work Syllabus Physics

M G K V P UNIVERSITY

VARANASI

Pre-Ph.D. Course Work Syllabus
Paper - I
RESEARCH METHODOLOGY

Unit- I

Definition of research, research hypothesis, objective & basic principles of research, motivation in research, meaning of research methodology, difference(s) between methods of research & research methodology. Research approaches and related tools, Types of research, significance of research, qualities of researcher, components of research problem, various steps in scientific research, research purposes, research design, overview of research, literature survey, research process in flow chart, conditions and criteria for good research. Importance of communication skill in research-development of power of expression in both speaking and writing, presentation techniques. Progress-report writing on the research topic(s). The dilemmas and the decision–makings the reality.

Unit- II

Fundamentals of computers Computer fundamentals, hardware and software, different operating systems, application programmes, Computer application for research, Word Processing, Excel, Power Point, Data Processing, Use of Web-2 tools for research, use of Graphical Software, Use of Multimedia Tools, Structure and Components of Research Report, Report writing, Seminar, Presentation. Types of Report: research papers, thesis. Research Project Reports, Pictures and Graphs, citation styles.

Unit- III

Working in a Linux environment, basic Linux commands, writing scientific documents with Latex, graphic and visualization, gnu plot; introduction to other useful software tools e.g. Mathematica computer programming. Difference between TEX and LATEX, basics of using latex, latex input files, input file structures, layout of the document, titles, chapter and sections, cross references, foot note, environments, typesetting, building blocks of a mathematical formula, matrices, tables, including encapsulated postscript graphics, bibliography, downloading and installing LATEX packages. Introduction to origin, basics of importing and exporting data, working with Microsoft excel, graphing, statistics in origin, basic linear regression and curve fitting, Method of least square fit to linear equation, Non-linear curve fitting, background correction, mathematical manipulation in data using origin.

Unit IV

Nature and Scope of Ethics, Challenges and Importance of Ethics, Ethics in Research, Ethics and Academic Honesty, Ethics in Writing, Academic Integrity, Research Misconduct/Fabrication/Unethical Practices Academic/Research: Falsification, Manipulation or Tempering of Data Literature. Review and Proper Use of E-Resources, Using Design thinking Methods to Avoid Plagiarism. Writing Quality Academic Publications, Scientific Reading, Cite and Write, Plagiarism Policies, Penalties and Consequences.

Text and Reference Books:

1. Kumar Ranjit, Research Methodology: A Step by Step Guide for Beginners, Sage Publication, 2014.
2. Kothari C.R. : Research Methodology, New Age International, 2011.
3. Thanulingom N : Research Methodology, Himalaya Publishing
4. C. Rajendar Kumar : Research Methodology , APH Publishing.
5. Pradeep K.Sinha, Computer Fundamentals - 8th Edition, BPB Publications
6. Nicola L. C. Talbot, LaTeX for Complete Novices
7. Stefan Kottwitz, LaTeX Beginner’s Guide, Packt Publishing, 2011
8. Muhammad Arsalan, Origin Software: A complete Guide for new users.
9. John G D'Angelo, Ethics in Science, Ethical Misconduct in Scientific Research.
10. Partha Pratim Ray, A Guide to Research and Publication Ethics.
11. Sandra C. Greer, Elements of Ethics for Physical Scientists.

Pre-Ph.D. Course Work Syllabus

Paper - II

EXPERIMENTAL TECHNIQUES IN PHYSICS

Unit – I

Quasielectrons, plasmons, The Dielectric constant of the electron gas, Ion-ion interactions; Phonons; Spin-spin interactions; Magnons; Diamagnetism; Paramagnetism. Theory of NMR, ESR techniques, Superconductivity, BCS Theory, Superfluidity.

Unit – II

Structural and Compositional Characterization, Basics of radiation matter interaction, Basics of electron matter interaction, Basic properties of Fourier Transform, Elastic Scattering, Diffraction of electrons, photons and neutrons. Basics of X – ray diffraction (XRD), grazing incidence and powder XRD, Energy Dispersive X-Ray analysis (EDX). Small Angle X-Ray Scattering (SAXS)**.**
Scanning Probe microscopy: Scanning Electron Microscopy (SEM), Atomic Force Microscopy (AFM), Magnetic Force Microscopy (MFM), Scanning Tunnelling Microscopy (STM), Transmission Electron microscopy (TEM): Basic principle, Brief idea of set up–details of components, Different modes and its importance.

Unit – III

Physical basis, theory, instrumentation and applications of X-Ray. Fluorescence Spectroscopy; LASER fluorimetry; Gamma-Gamma method; Neutron activation analysis and Neutron-Neutron method. Gamma Ray Spectrometric Technique. Magnetic Neutron Scattering, Small Angle Neutron Scattering (SANS), Neutron reflectometry for thin film.

Unit – IV

X- Ray Photoelectron Spectroscopy: Basic Components of Raman system, Spectrometer and Detectors, Raman Spectroscopy of Solid and Liquids, Raman spectroscopy of Materials, Instrumentation, Basic Components, IR sources. Spectrometer and Detectors, Infrared absorption spectroscopy. FWHM of the vibrational modes, area etc. Fourier Transform Infrared Spectroscopy (FTIR), UV- Vis. Spectroscopy.

Text and Reference Books:

1. Nadia Crawford, Nuclear Physics: Concepts and Techniques
2. Stefaan Tavernier, Experimental Techniques in Nuclear and Particle Physics.
3. Neil W. Ashcroft, N. David Mermin, Solid State Physics.
4. Charles Kittel, Introduction to Solid State Physics.
5. H. Ibach, Solid State Physics: An Introduction to Theory and Experiment.
6. James D. Patterson, Bernard C. Bailey, Solid-State Physics: Introduction to the Theory.
7. Hendrik Bluhm, Thomas Brckel, Markus Morgenstern, Gero Von Plessen, Advanced Solid State Physics.
8. Thomas C. Weinacht, Brett J. Pearson, Time-Resolved Spectroscopy: An Experimental Perspective.
9. M. I. Pergament, Methods of Experimental Physics
10. F. Reif*:* Fundamentals of Statistical and Thermal Physics.
11. R. Pathria: Statistical Mechanics.
12. Donald H. Perkins*:* Introduction to high energy physics
13. Mandl, Shaw*:* Quantum Field Theory.
14. Demtroeder W, Molecular Physics - Theoretical Principles and Experimental Methods

Pre-Ph.D. Course Work Syllabus
Paper - III
THEORETICAL METHODS IN PHYSICS Research

UNIT – I

Ion beam Technology, Ion beam irradiation and ion implantation in physics research especially in materials science, nuclear physics and plasma physics. Basics of nuclear techniques for ion beam analysis.

UNIT- II

Quantum confinement and surface effect, 2-D, 1-D and 0-D Nano systems, Quantum dots and 1-D nanostructures, Nanocomposites of inorganic and organic systems, Self-assembly hierarchic structures and advanced functional materials for applications in energy harvesting, catalysis, sensors etc.

UNIT III

The electron gas without interaction; Electrons in a periodic potential. The interacting electron gas; Schrodinger Perturbation Theory, Scattering Theory, Partial Wave Analysis, Born Approximation and Its validity. The Hartree-Fock approximation, Computational Techniques: Basics of ab-initio calculations, basic principles of density functional theory (DFT), exchange correlation energy functional, applications of DFT.

UNIT IV

Landau theory for phase transitions. Ising model: transfer matrix method; Onsager solution of 2-dimensional Ising model. Non-equilibrium Statistical Mechanics: Response function and susceptibility; fluctuation-dissipation theorem; irreversibility and the master equation; Fokker Planck and diffusion equations.

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1. Nadia Crawford, Nuclear Physics: Concepts and Techniques
2. Stefaan Tavernier, Experimental Techniques in Nuclear and Particle Physics.
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