Ph.D. Coursework

RESEARCH METHODOLOGY (Credits: 4)

Course code: CTPH 102

Centre for Theoretical Physics, Jamia Millia Islamia

Course Syllabus (Revised 2023):

- **Introduction to Research Methodology**

  Meaning of Research, Objectives of Research, Types of Research Research and Scientic Method
  Publishing research work, research journals, journal types, concept of peer-review, impact factors, open-access publishing
  Physics preprint archives: ArXiv.org, sharing research work
  Ethics in publishing, author credits, acknowledging funding agencies etc

- **Computer programming in Python**

  Introduction to *Python*: Variables, statements, conditional statements, loops, I/O statements
  Python arrays, Python functions

- **Numerical Techniques in Physics Research**

  Summation of finite and infite series
  Roots of an equation: bracketing & bisection, Newton-Raphson methods
  Sorting, interpolation, extrapolation,
  Curve-ftting: Least square fit, linear and nonlinear regression
  Numerical differentiation. Numerical integration: Trapezoidal & Simpson rules.
  Solution of differential equations: Euler and Runge-Kutta methods.
  Random numbers, Covariance and Correlation.
  Monte Carlo integration. Monte-Carlo simulation of Ising model.

- **Writing a research paper**

  Anatomy of a research paper: IMRAD (Introduction, methodology, results, analysis, discussion)
  Introduction to LaTeX. Oral presentation of research. Guidelines for a good oral presentation.

Recommended Books:

1. C. R. Kothari; Research Methodology New Age International

2. Eric Matthes; Python Crash Course (No Starch Press, 2016).

3. Numerical Recipes: The Art of Scientific Computing, 3rd Edition (2007), W.H. Press et. al.

4. Introductory Methods of Numerical Analysis, 5th edition, S.S. Sastry (PHI, 2005).