Centre for Theoretical Physics
Jamia Millia Islamia
CTP GRADUATE SCHOOL COURSE

RESEARCH METHODOLOGY
Syllabus (Revised 2015)

1. **Introduction to Research Methodology.**

   Meaning of Research, Objectives of Research, Types of Research

   Research and Scientific 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.

2. **Computer programming in Fortran 90**

   Introduction to Fortran 90: Variables, statements, conditional statements, do loops, I/O statements

   Matrices and arrays, functions and subroutines

3. **Numerical Techniques in Physics Research**

   Summation of finite and infinite series

   Roots of an equation: bracketing & bisection, Newton-Raphson methods

   Sorting, interpolation, extrapolation,

   Curve-fitting: 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.

4. **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.

Books recommended:

1. C. R. Kothari; Research Methodology New Age International
2. Computer Programming in FORTRAN 90 and 95, V. Rajaraman (PHI 1997).
3. Numerical Recipes in Fortran 77: The Art of Scientific Computing, 2nd Edition (1992), W.H. Press et. al.
4. Introductory Methods of Numerical Analysis, 5th edition, S.S. Sastry (PHI, 2005).