

Paper - I: RESEARCH METHODOLOGY

Max. Marks: 100

Objective: To enlighten newly admitted scholars about the basic concepts of research, methods & methodology and research ethics. Scholars will be guided toward research database, mathematical software's like MATLAB, Scientific documentation LaTeX, C-programming and numerical methods.

Outcome of this course: After the completion of this course, the scholars shall be able to handle research problems with scientific temperament and can also deal with the research problems with latest tools and techniques.

UNIT-I: Research and Publication Ethics

Research – Meaning, motivation, objectives and types of research, Identification of a research problem, research Methods vs Methodology. Scientific conduct: Intellectual honesty and research integrity. Plagiarism, conflicts of interest, violation of publication ethics, predatory publishers and journals. Research design and drafting of synopsis, writing research grant proposals. paper writing skills. Indexing database: citation databases, web of science, Scopus, MathSciNet, SCl, ESCI etc.. Impact factor, H-index, Google scholar. Use of plagiarism software's like Turnitin. Urkund and other open source software tools.

Unit – II: Computer Methods for Research in Mathematics

Basics of C-Programming: Tokens, Keywords and Identifiers, Variables and Constants; Data types in C; Input/output in C; Operators in C; Control Statements and Loops; Functions in C; Arrays and strings; Concept of Pointers and user defined data types (Structure, Union); Recursion in C; Basic File Operations.

MATLAB Essentials: Matrix Operations & plotting using MATLAB; Array design and Operations (1D, 2D and 3D); Relational Operators, Loops & Functions using MATLAB; Mathematical Functions in MATLAB; Equations in MATLAB – Linear and Non Linear Equations, ODE, DAE and PDE Software tools.

Basics of LateX: LateX compilers and TeX files; Document classes; Adding tables and figures;

Equations in Latex: Adding Bibliography in TeX files; Submitting LateX files for publication; Preparing Presentations in LateX (Beamer).

Unit III: Matrices and Linear Algebra

Matrices Eigenvalues and eigenvectors of a matrix, Brouwer's theorem, Companion matrix, Gereshgorian disc theorem, Positive semi-definite matrices, Fisher's inequality, Schur compliment and determinant inequalities. Hua determinant inequality, Courant-Fisher theorem, Perturbation of eigenvalues of normal matrices, Hoffman-Weilandt theorem and Sun theorem.


Unit IV: Numerical Methods

Numerical Methods Finite Difference Calculus. Forward, Backward and Central differences, Differences of a Polynomial, Newton's and Lagrange's formulae for interpolation, Spline interpolations, Linear and Quadratic, Solution of heat, wave and Laplace equations by difference methods.

RECOMMENDED BOOKS

1. P. Chaddah, Ethics in Competitive Research: Do not forget scooped; do not get plagiarized, ISMB: 978-9387480865, 2018.
2. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance, ISBN: 978-939482-1-7, 2019.
3. Research Methodology: Methods and Techniques, Kothari, C.R., New Age International, 2019.
4. The MathWorks Inc. MATLAB 9.4, The MathWorks Inc., R2022a.
5. S. J. Chapman. MATLAB Programming for Engineers. Thomson, 2004
6. L. Lamport, LaTeX, A Documentation System, 2nd ed., Addison-Wesley, 1994.
7. Nicholas J. Higham, Handbook of Writing for the mathematical Sciences, 2nd ed. SIAM, 1998.
8. Franz E.Honz, Elementary matrix Algebra, Dover Publications, 2013.
9. Rager A.Han and C.R. Johnson, matrix Analysis, Cambridge University Press, 2012.
10. S.S.Shastry, Introduction to Numerical Methods, PHI. 5th Edition, 2012.

DRC Members



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