

Name of the Programme: Ph.D (Mathematics)

Course Code: MAT-700

Title of the Course: Research Methodology

Number of Credits: 04

Effective from AY: 2022-23

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| <b>Prerequisites for the course:</b> | M.Sc. in Mathematics   |          |
| <b>Objective:</b>                    | The aim of course is to orient Pre-PhD students towards research by introducing them to research methodology.  |          |
| <b>Content:</b>                      | <b>UNIT I: BASICS OF RESEARCH</b><br>History of Mathematics, Overview of scientific research, Understanding research methodology in Mathematics, Strategies for investigating problems, Tactics for solving problems, Literature survey and critical review of the topic and a problem, Selection of a research topic, Formulating the research problem, Studying and reviewing a paper, Designing the research, Structure and components of scientific reports – Types of reports – Technical reports and thesis – Significance – Different steps in the preparation – Layout, structure and language of typical reports, Importance of effective communication.  | 20 Hours |
|                                      | <b>UNIT II: MATHEMATICAL SOFTWARE</b><br>Knowledge of SageMath/Scilab/Python/R/MATLAB/Mathematica for: Plotting 2D and 3D Graphs, Programming, Handling Computational Calculus, Algebra and Linear Algebra, Solving Differential Equations.  | 15 Hours |
|                                      | <b>UNIT III: TYPESETTING AND PRESENTATION USING LATEX</b><br>Basics – Line Breaking and Page Breaking, Ready-Made Strings, Dashes and Hyphens, Slash, Ellipsis, Ligatures, Abstract, Simple Commands, The Space Between Words, Titles, Chapters, and Sections, Page Customization, Page Numbering. Typesetting Mathematical Formulae – Modern Mathematics, Single Equations, Building Blocks for Mathematical Formulae, Multiline Equations, Units, Matrices and Determinants, Spacing in Math mode, Theorems and Proofs. Bibliographies – Bibliography environment, biblatex with biber Database files, Cross Referencing, Using biblatex, Controlling the bibliography, Citing commands, Generating Table of Contents. Graphics – Overview, Basic Usage, Curves and Shapes, Customizing Paths and Nodes, Coordinates, Reusing Pictures, Creating Tables, Libraries. Customising LaTeX – New Commands, Environments and Packages, Fonts and Sizes, Custom Fonts with fontspec, Colours, Lengths and Spacing, The Layout of the Document, Fancy Headers. Presentation Tools and Skills – Beamer as a tool for paper and thesis presentations, Oral and poster presentations. | 20 Hours |
|                                      | <b>UNIT IV: FUNDING</b><br>Writing a research proposal, Proposal vs Report, Funding agencies, Types of research grants.  | 5 Hours  |
| <b>Pedagogy:</b>                     | Reading/Discussion/Assignments/Presentations   |          |

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| <b>References/<br/>Readings</b> | <ol style="list-style-type: none"> <li>1. Mathematics and its History, John Stillwell, Springer, 2012.</li> <li>2. The Art and Craft of Problem Solving, Paul Zeitz, John Wiley &amp; Sons, 2019.</li> <li>3. How to Solve It – a new aspect of mathematical method, G. Polya, Princeton University Press, 2014.</li> <li>4. C. George Thomas, “Research Methodology and Scientific Writing”, Springer, 2021.</li> <li>5. Computational Mathematics with SageMath, Paul Zimmermann, Society for Industrial &amp; Applied Mathematics, 2018.</li> <li>6. Tobias Oetiker, Marcin Serwin, Hubert Partl, Irene Hyna and Elisabeth Schlegl, Latex in 157 minutes: The Not So Short Introduction to Latex, Samurai Media Limited, 2015.</li> </ol> |
| <b>Course Outcomes:</b>         | <ol style="list-style-type: none"> <li>1. The students will exhibit higher maturity in terms of designing and developing their research work by critically planning, executing, and defending their research.</li> <li>2. The student will learn to effectively use Mathematical software for various computations.</li> <li>3. The students will appreciate and discover more of LaTeX.</li> <li>4. The students will be made aware on writing research projects and seeking financial assistance from various avenues.</li> </ol>  |