

transforms, Convolution properties of Fourier transform; Laplace transforms, Properties of Laplace transforms, Convolution theorem and properties of the Laplace transform, Laplace transforms of the heaviside and Dirac delta functions.

### **UNIT-III: Applications of Integral Transforms (12 hours)**

Finite Fourier transforms and applications, Applications of Fourier transform to ordinary and partial differential equations; Applications of Laplace transform to ordinary differential equations, partial differential equations, initial and boundary value problems.

#### **Essential Readings**

1. Tyn Myint-U & Lokenath Debnath (2007). Linear Partial Differential Equations for Scientists and Engineers (4th ed.). Birkhauser. Indian Reprint.
2. Lokenath Debnath & Dambaru Bhatta (2015). Integral Transforms and Their Applications (3rd ed.). CRC Press Taylor & Francis Group.

#### **Suggestive Readings**

- Baidyanath Patra (2018). An Introduction to Integral Transforms. CRC Press.
- Joel L. Schiff (1999). The Laplace Transform-Theory and Applications. Springer.
- Rajendra Bhatia (2003). Fourier Series (2nd ed.). Texts and Readings in Mathematics, Hindustan Book Agency, Delhi.
- Yitzhak Katznelson (2004). An Introduction to Harmonic Analysis (3rd ed.). Cambridge University Press.

### **DISCIPLINE SPECIFIC ELECTIVE COURSE – 4(iii): RESEARCH METHODOLOGY**

#### **CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/Practice		
Research Methodology	4	3	0	1	Class XII pass with Mathematics	NIL

**Learning Objectives:** The main objective of this course is to:

- Prepare the students with skills needed for successful research in mathematics.
- Develop a basic understanding of how to pursue research in mathematics.
- Prepare students for professions other than teaching, that requires independent mathematical research, critical analysis, and advanced mathematical knowledge.
- Introduce some open source softwares to carry out mathematical research.
- Impart the knowledge of journals, their rankings and the disadvantages of rankings.

**Learning Outcomes:** The course will enable the students to:

- Develop researchable questions and to make them inquisitive enough to search and verify new mathematical facts.
- Understand the methods in research and carry out independent study in areas of mathematics.
- Write a basic mathematical article and a research project.
- Gain knowledge about publication of research articles in good journals.
- Communicate mathematical ideas both in oral and written forms effectively.

### **SYLLABUS OF DSE - 4(iii)**

#### **UNIT– I: How to Learn, Write, and Research Mathematics (17 hours)**

How to learn mathematics, How to write mathematics: Goals of mathematical writing, general principles of mathematical writing, avoiding errors, writing mathematical solutions and proofs, the revision process, What is mathematical research, finding a research topic, Literature survey, Research Criteria, Format of a research article (including examples of mathematical articles) and a research project (report), publishing research.

#### **UNIT- II: Mathematical Typesetting and Presentation using LaTeX (16 hours)**

How to present mathematics: Preparing a mathematical talk, Oral presentation, Use of technology which includes LaTeX, PSTricks and Beamer; Poster presentation.

#### **UNIT- III: Mathematical Web Resources and Research Ethics (12 hours)**

Web resources- MAA, AMS, SIAM, arXiv, ResearchGate; Journal metrics: Impact factor of journal as per JCR, MCQ, SNIP, SJR, Google Scholar metric; Challenges of journal metrics; Reviews/Databases: MathSciNet, zbMath, Web of Science, Scopus; Ethics with respect to science and research, Plagiarism check using software like URKUND/Ouriginal by Turnitin.

### **Essential Readings**

1. Bindner, Donald, & Erickson Martin (2011). *A Student's Guide to the Study, Practice, and Tools of Modern Mathematics*. CRC Press, Taylor & Francis Group.
2. Committee on Publication Ethics- COPE (<https://publicationethics.org/>)
3. Declaration on Research Assessment.  
[https://en.wikipedia.org/wiki/San\\_Francisco\\_Declaration\\_on\\_Research\\_Assessment](https://en.wikipedia.org/wiki/San_Francisco_Declaration_on_Research_Assessment)
4. Evaluating Journals using journal metrics;  
(<https://academicguides.waldenu.edu/library/journalmetrics#s-lg-box-13497874>)
5. Gallian, Joseph A. (2006). *Advice on Giving a Good PowerPoint Presentation* (<https://www.d.umn.edu/~jgallian/goodPPtalk.pdf>). MATH HORIZONS.
6. Lamport, Leslie (2008). *LaTeX, a Document Preparation System*, Pearson.
7. Locharoenrat, Kitsakorn (2017). *Research Methodologies for Beginners*, Pan Stanford Publishing Pte. Ltd., Singapore.
8. Nicholas J. Higham. *Handbook for writing for the Mathematical Sciences*, SIAM, 1998.
9. Steenrod, Norman E., Halmos, Paul R., Schiffer, M. M., & Dieudonné, Jean A. (1973). *How to Write Mathematics*, American Mathematical Society.

10. Tantau, Till, Wright, Joseph, & Miletic, Vedran (2023). The BEAMER class, Use Guide for Version 3.69. TeX User Group.  
(<https://tug.ctan.org/macros/latex/contrib/beamer/doc/beameruserguide.pdf>)
11. University Grants Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations 2018 (The Gazette of India: Extraordinary, Part-iii-Sec.4)

**Practical (30 hours):** Practical work to be performed in the computer lab of the following using any TeX distribution software:

1. Starting LaTeX, Preparing an input file, Sequences and paragraphs, Quotation marks, Dashes, Space after a period, Special symbols, Simple text- generating commands, Emphasizing text, Preventing line breaks, Footnotes, ignorable input.
2. The document, The document class, The title page, Sectioning, Displayed material, Quotations, Lists, Displayed formulas, Declarations.
3. Running LaTeX, Changing the type style, Accents, Symbols, Subscripts and superscripts, Fractions, Roots, Ellipsis.
4. Mathematical Symbols, Greek letters, Calligraphic letters, Log-like functions, Arrays, The array environment, Vertical alignment, Delimiters, Multiline formulas.
5. Putting one thing above another, Over and underlining, Accents, Stacking symbols, Spacing in math mode, Changing style in math mode, Type style, Math style.
6. Defining commands, Defining environments, Theorems.
7. Figure and tables, Marginal notes, The tabbing environment, The tabular environment.
8. The Table and contents, Cross-references, Bibliography and citation.
9. Beamer: Templates, Frames, Title page frame, Blocks, Simple overlays, Themes.
10. PSTricks
11. Demonstration of web resources.