

**Department of Mathematics**  
**Central University of Tamil Nadu, Thiruvarur**  
Course Structure for Ph. D. Mathematics

(The syllabus finalized in the BoS meeting held on 04.03.2022)

Sl.No.	Course code	Course title	Type	Credits
1	MAT601	Research Methodology (Mathematics)	Core	4
2	MAT602	Advanced Topics in Mathematics	Core	4
3	CPE-RPE	Research and Publications Ethics	Core	2
4	—	Course on Specialization*	Elective	4

\* The title and syllabus for the elective course may be given for each scholar by his/her supervisor.

**Research Methodology (Mathematics)**

1. Asking right questions and answering them: Questions, mental operations, generality, common sense, understanding the problem, devising the plan, carrying out the plan, looking back, various approaches to do the above.
2. Constructive proof versus existence proof. Checking the result, verifying the result, using the result. Different ways of approaching a result. Uses of different approaches with example. Variations of the same questions. Same question in different settings. Mathematics and visualization, geometry etc., Fallacies Challenges and difficulties of being a mathematician.
3. Brief history of mathematics and research in mathematics. Mathematical Research during the world wars and after that. Plagiarism in mathematical research. Preparing Projects proposals and project reports.
4. Ethics in research & Seminar Presentation: Introduction to research methods - methods of data collection - need for ethics in data collection, analysis and reporting - specific examples - unethical data collection - ignoring outliers - intrapolating non existent data etc., - logical fallacies encountered in data analysis - pyramid of logical fallacies - seminar presentation basics - use of presentation slides with respect to font size, colors, content etc.
5. Literature Survey : Types of Journals: Paid journals, Open access journals, Preprints, reprints. Articles, Letters, Reports, Reviews, replies, Erratum. Key Words, AMS Subject Classification numbers, Impact factors. Conference, Symposium, Workshop, School. Lecture notes, Proceedings, volumes, Issues. Referees, Editors, Authors. Single author and many authors, First author, Corresponding authors, percentage of author's contributions.

**References:**

1. G. Polya, How to Solve It. A New Aspect of Mathematical Method, Princeton University Press, New Jersey, 1945.
2. P. Lockhart, A Mathematician's Lament, MAA, 2009.
3. R. B. Bapat, Challenges and frustrations of being a mathematician
4. H. Schubert, Mathematical Recreations and Essays, Nabu Press, 2012.
5. A. De Morgan, On the study and difficulties of mathematics, The Open court publishing company, London,1910.
6. D.B. Resnik, What is Ethics in Research & Why is it Important?, National Institutes of Health, 2015. <http://www.niehs.nih.gov/research/resources/bioethics/whatis/>

7. P. Ravilochanan, Research Methodology with Business correspondence and Report Writing, MARGHAM Publications, 2005.
8. J. Anderson, Thesis and assignment writing, Wiley Eastern Ltd, 1970.
9. C. Kothari, Research Methodology methods & Techniques, Wiley Eastern Ltd, 1990.

**Advanced Topics in Mathematics**

1. Separation properties, Linear mappings, Finite-dimensional spaces, Metrization, Boundedness and continuity, Seminorms and local convexity, Quotient spaces, Examples.
2. Test functions and Distribution, Derivatives of distributions, Convolution of Distributions, Tempered Distributions, Fourier Transform.
3. Motivation, Weak derivative, Definition and basic properties of Sobolev spaces, Approximation, Extension theorem, Sobolev inequalities, Compactness.
4. Modules, Module homomorphism, Submodules, Quotient modules, Operations on submodules, Direct sum and product, Finitely Generated modules, Nakayama's lemma.
5. Exact sequences - Tensor product of modules, Projective modules and Injective modules

**References:**

1. W. Rudin, Functional Analysis, Second Edition, McGraw Hill, Inc., New York, 1991.
2. S. Kesavan, Topics in Functional Analysis and Applications, Second edition, New Age International Private Limited, 2015.
3. R.S. Pathak, A Course in Distribution Theory and Applications, Alpha Science, 2001.
4. L.C. Evans, Partial Differential Equations, Second edition, Springer, AMS, 2010
5. A. H. Zemanian, Distribution Theory and Transform Analysis: An Introduction to Generalized Functions, with Applications, Dover, 2003.
6. H. Brezis, Functional Analysis, Sobolev Spaces and Partial Differential Equations, Springer, New York, 2011.
7. M.F. Atiyah and I.G. MacDonald, Introduction to Commutative Algebra, Addison- Wesley, Reading, 1969.
8. D.S. Dummit and R.M. Foote, Abstract Algebra Third Edition, Wiley Publications, 2016.
9. S. Lang, Algebra, Revised Third Edition, Springer Graduate Texts in Mathematics, 2005.

## Research and Publication Ethics

### Course structure

- The course comprises of six modules listed in table below. Each module has 4-5 units.

Modules	Unit title	Teaching hours
<b>Theory</b>		
RPE 01	Philosophy and Ethics	4
RPE 02	Scientific Conduct	4
RPE 03	Publication Ethics	7
<b>Practice</b>		
RPE 04	Open Access Publishing	4
RPE 05	Publication Misconduct	4
RPE 06	Databases and Research Metrics	7
	<b>Total</b>	<b>30</b>

### Syllabus in detail

#### THEORY

- RPE 01: PHILOSOPHY AND ETHICS (3 hrs.)**
  - Introduction to philosophy: definition, nature and scope, concept, branches
  - Ethics: definition, moral philosophy, nature of moral judgements and reactions
- RPE 02: SCIENTIFIC CONDUCT (5hrs.)**
  - Ethics with respect to science and research
  - Intellectual honesty and research integrity
  - Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP)
  - Redundant publications: duplicate and overlapping publications, salami slicing
  - Selective reporting and misrepresentation of data
- RPE 03: PUBLICATION ETHICS (7 hrs.)**
  - Publication ethics: definition, introduction and importance
  - Best practices / standards setting initiatives and guidelines: COPE, WAME, etc.
  - Conflicts of interest
  - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types
  - Violation of publication ethics, authorship and contributorship
  - Identification of publication misconduct, complaints and appeals
  - Predatory publishers and journals

#### PRACTICE

- RPE 04: OPEN ACCESS PUBLISHING(4 hrs.)**

1. Open access publications and initiatives
  2. SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies
  3. Software tool to identify predatory publications developed by SPPU
  4. Journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.
- **RPE 05: PUBLICATION MISCONDUCT (4hrs.)**
    - A. Group Discussions (2 hrs.)**
      1. Subject specific ethical issues, FFP, authorship
      2. Conflicts of interest
      3. Complaints and appeals: examples and fraud from India and abroad
    - B. Software tools (2 hrs.)**

Use of plagiarism software like Turnitin, Urkund and other open source software tools
  - **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)**
    - A. Databases (4 hrs.)**
      1. Indexing databases
      2. Citation databases: Web of Science, Scopus, etc.
    - B. Research Metrics (3 hrs.)**
      1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
      2. Metrics: h-index, g index, i10 index, altmetrics

## References

- Bird, A. (2006). *Philosophy of Science*. Routledge.
- MacIntyre, Alasdair (1967) *A Short History of Ethics*. London.
- P. Chaddah, (2018) *Ethics in Competitive Research: Do not get scooped; do not get plagiarized*, ISBN:978-9387480865
- National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009). *On Being a Scientist: A Guide to Responsible Conduct in Research: Third Edition*. National Academies Press.
- Resnik, D. B. (2011). What is ethics in research & why is it important. *National Institute of Environmental Health Sciences*, 1–10. Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
- Beall, J. (2012). Predatory publishers are corrupting open access. *Nature*, 489(7415), 179–179. <https://doi.org/10.1038/489179a>
- Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance*(2019), ISBN:978-81-939482-1-7. [http://www.insaindia.res.in/pdf/Ethics\\_Book.pdf](http://www.insaindia.res.in/pdf/Ethics_Book.pdf)