23RM801   Research Methodology for Mathematics   4 0 0 4

Course Overview

This course will establish a systematic approach to research in mathematics. The students are introduced to various procedures, techniques, and ethical principles, including general problem-solving techniques; reading and writing research articles; research tools for type-setting, presentations, and literature surveys; e-resources, and ranking.

Course Outcomes

CO1: To understand several types of research, objectives for doing research, and ethics in research.

CO2: To understand the fundamentals of logical reasoning in pure mathematics, modeling aspects of applied mathematics, and meaningful interpretation of data sets in Statistics and Data Science.

CO3: Understanding various stages of research, from identifying a problem to publishing a research article.

CO4: Familiarize with various open-source research tools and mathematical software.

Course Syllabus

Unit – 1

Research: Definition, Concepts, and General introduction, Different approaches to research - Basic, Applied, Interdisciplinary, Multidisciplinary.

Ethics in research: Definition, moral philosophy, scientific conduct, intellectual honesty, and research integrity, scientific misconducts - falsification, fabrication and plagiarism, Redundant publications - duplication, overlapping publications, and salami slicing.

Unit – 2

Mathematical Statements, Logic, Sufficient and Necessary Conditions, Contrapositive, Converse, Negation, Direct and Indirect Proofs, Principle of Induction, Axiom of Choice, Zorn's Lemma, Inductive reasoning, Deductive reasoning, Proof by Contradiction, Counterexamples. Mathematical modelling, Problem Formulation, Approximations, Analytical and Numerical solutions, Error Analysis, and Interpretation.

Data collection, sampling methods, data analysis, data visualization, and statistical hypothesis testing. Statistical software (SPSS) for data analysis.

Unit – 3

Databases – Indexing databases, Citation databases: Web of Science, Scopus, etc.

Research Metrics – Impact factor, SNIP, SJR, IPP, Cite Score, h-index, g-index, i10 index, altmetrics.

Scientific writing – Latex (documentation and beamer presentation), References and citations (Medley, Jabref), plagiarism, intellectual property rights, copyrights, preprints (arXiv), open access.

Text Books

1. Research Design and Methods – A Process Approach, Bordens, K. S. and Abbott, B. B., Eighth Edition, McGraw-Hill, 2011.

2. Research Methodology – Methods and Techniques, C. R. Kothari, Second Edition, New Age International Publishers, 2004.

3. Research Methodology and Scientific Writing, C. George Thomas, Springer Nature, 2015.

4. Topology, James R Munkres, Second Edition, Prentice Hall of India, 2002.

Reference Books

1. Philosophy of Science, Bird A, Routledge, 2006.

2. A Short History of Ethics, Maclntyre, Alasdair, Routledge, 2002.

3. Ethics in Competitive Research: Do not get scooped; do not get plagiarized, Praveen Chaddah, 2018.

4. Scientific Papers and Presentations, Davis, M., Davis K., and Dunagan M., Third Edition, Elsevier

5. Research Methods for Science, Michael P. Marder, Cambridge University Press, 2011

Evaluation Pattern

Internal (70%): Worksheets, Assignments, Quizzes

External (30%): Presentation and Viva