

Course Code	Course Name	Credits
26BY555	RESEARCH METHODOLOGY AND SCIENTIFIC WRITING IN NATURAL SCIENCES WITH AI APPLICATIONS	04

Course Objectives

- To introduce students to the fundamental principles of scientific research methods.
- To develop skills in data collection and statistical analysis used in natural science research.
- To enhance abilities in scientific writing, research problem identification, hypothesis formulation, and ethical research practices.
- To familiarize students with digital technologies, statistical software, and AI-based tools for data analysis and scientific investigation.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Understand the principles of research methodology in natural sciences.
- Develop knowledge of data collection and statistical analysis techniques.
- Apply scientific writing skills and ethical research practices in preparing research reports and publications.
- Use digital technologies, statistical software, and AI-based tools for data analysis and scientific investigation.

Unit 1 - Natural Science – Research and Scientific Methods (12 Hrs.)

Introduction to natural science research and its importance; essential qualities of a researcher, including the use of digital and AI-based tools; research methods and logical approaches - deductive, inductive, and deductive - inductive, along with their patterns; inductive methods - method of agreement, difference, joint agreement and difference, concomitant variation, residues, and causal connections.

Unit 2 – Types of Research and Data Collection (12 Hrs.)

Types of research—descriptive, analytical, fundamental, applied, qualitative, quantitative, conceptual, and empirical; survey research; longitudinal and cross-sectional, correlational, and experimental studies. Data collection including primary and secondary data, methods, limitations, and precautions; identification of research problems, formulation and types of hypotheses, execution of research work, and general laboratory rules and regulations; Application of AI tools for automated data collection and machine learning-based analysis.

Unit 3 - Statistical Applications in Research (12 Hrs.)

Introduction to statistics; measures of central tendency- mean, median, mode, and proportions; measures of dispersion- range, variance, standard deviation, and coefficient of variation; standard error; diversity and similarity indices - Sorenson's index and coefficient of community; correlation and regression; tests of significance including ANOVA; use of computers, statistical software, and AI-assisted data analysis tools in plant science research.

Unit 4 – Scientific Writing (12 Hrs.)

Preparation of research proposals, research papers, research reports, and dissertations/theses. Style and structure of scientific writing; guidelines for writing titles; preparation of abstracts; writing the introduction and review of literature; presentation of materials and methods and results; preparation of discussion, summary, and conclusion; Reference and citation styles, with the use of AI-assisted writing and reference management tools.

Unit 5 - Research Ethics and Scientific Tools (12 Hrs.)

Bioethical issues in research; intellectual property rights (IPR) and their types; ethics in scientific publications with emphasis on plagiarism and its types, and the use of plagiarism detection softwares. Tools and techniques for research, including effective information retrieval, use of reference management software (e.g., Mendeley), and software for manuscript preparation and formatting (MS Office) with the use of AI-assisted research tools.

Reference Books:

1. Kothari, C. R., and Garg, G. (2019). Research Methodology: Methods and Techniques (4th Edition). New Age International Publishers, New Delhi.
2. Creswell, J. W., and Creswell, J. D. (2018). Research Design: Qualitative, Quantitative and Mixed Methods Approaches (5th Edition). SAGE Publications, Thousand Oaks, California.
3. Zar, J. H. (2010). Biostatistical Analysis (5th Edition). Pearson Education, New Delhi.
4. Sokal, R. R., & Rohlf, F. J. (2012). Biometry: The Principles and Practice of Statistics in Biological Research (4th Edition). W.H. Freeman and Company, New York.
5. Gomez, K. A., and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research (2nd Edition). John Wiley & Sons, New York.
6. Day, R. A., and Gastel, B. (2012). How to Write and Publish a Scientific Paper (7th Edition). Cambridge University Press, Cambridge.
7. Russell, M. A., and Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th Edition). Pearson Education, London.