

Department of Botany, Govt. Degree College Baramulla (Autonomous)

(NAAC Re-accredited Grade A and CPE status)

Syllabus 7th Semester (4 years Honours with Research Degree Course)

Subject: Botany

Title: Research Methodology in Botany (Credits: 4 theory)

Paper Code: BOTR4722M

No. of Contact hours: 64

Course Learning Objectives (CLOs)

By the end of the course, students will be able to:

1. **Explain and apply** fundamental concepts of research, including types, processes, ethics, hypothesis formulation, literature review.
2. **Demonstrate** proficiency in general laboratory practices, including solution preparation, microscopy techniques, safety protocols, and basic computer applications in biological research.
3. **Understand the principles, working and application** of advanced biological research instruments and techniques, including various microscopy methods and centrifugation types.
4. **Understand methodology and application** of various chromatographic techniques, spectroscopic and spectrometric techniques

Unit I: Basic Concepts of Research

Research: Definition, aims and significance; types of research; research and scientific method, laboratory research and field research. Field and herbarium techniques.

Research Process: Concept of Research design (Principle of Replication, randomization and Local control); experimental layout. Formulating of research problem, Literature-review, methods of data collection, data analysis, research processes flow-chart.

Research funding agencies (DBT, CSIR, DST, MoEF, UGC and ICMR), major research institutes of plant sciences in India.

Unit II: General Laboratory Practices

Preparation of solutions (percentage, molar, molal and normal solutions); dilutions, preparation and procedure of stains and fixatives.

Methods to study plant cells/ tissues: whole mount, peel mount, squash preparations, maceration and sectioning, techniques of handling micropipettes.

Laboratory safety: Biological hazards. Awareness of common toxic chemicals and safety measures during their handling. Laboratory waste disposal management.

Photography and basic computer applications in biological research.

Unit-3. Microscopy and Centrifugation:

Compound, Bright field and dark field microscopy, Phase contrast, Fluorescence, Confocal microscopy, Electron microscopy - Principles and application of Scanning electron microscope (SEM) and Transmission electron microscope (TEM).

Centrifugation- Principles, components and factors affecting sedimentation. Types of centrifugation – Differential, Density gradient centrifugation, Ultracentrifugation,

Unit 4. Chromatography, Spectrometry and Spectroscopy

Principle of chromatography - Adsorption chromatography and partition chromatography, Paper chromatography, thin layer chromatography, Column chromatography, High Performance Liquid chromatography (HPLC)

Mass spectrometry – Principles, instrumentation and applications of: gas chromatography and liquid chromatography coupled with mass spectrometry.

Concept of spectroscopy: Beer Lambert's law, Visible and UV spectroscopy, Infrared (IR) spectroscopy.

Suggested Readings

1. Kothari C.R. and G. Garg (2023) *Research Methodology: Methods and Techniques*. 5th Edition 2023. New Age International publishers, New Dehli, India
2. Narayana P.S., D. Varalakshmi, T. Pullaiah (2016). *Research Methodology in Plant Science*. Scientific Publishers, Jodhpur, India
3. Kumar R. (2012) *Research Methodology: Step By Step Guide for Beginners*. SAGE Publishers, New Dehli, India
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicines (2009). *On Being a Scientist: a Guide to Responsible Conduct in Research*, 3rd Edition. National Academic Press, Washington DC USA
5. Wilson, W. and Walker J. (2010). *Principles and Techniques of Biochemistry and Molecular Biology*; Cambridge University press, 7th Edition.
6. Karp, G., Iwasa, J. and Marshall W. (2021). *Cell and Molecular Biology: Concepts and experiments*. Wiley, 9th Edition.
7. Sadasivam, S. and Manickam, A. (2008). *Biochemical methods*. New age international (P) limited publishers, 3rd Edition.
8. Kumar, P. (2024). *Biophysics and molecular biology: tools and techniques*. Pearson Education India, 5th Edition.