

**Shiksha Mandal's
Bajaj College of Science, Wardha**

**Proposed Syllabus for M.Sc. semester-I
Program**

(Academic Session 2023-24)

**Syllabus
DISCIPLINE SPECIFIC CORE (DSC),
DISCIPLINE SPECIFIC ELECTIVES (DSE),
AND OTHER COURSES**

**MSc- Semester I / BSc- semester-VII courses
in Botany**

**Syllabus under Autonomy
As per National Education Policy (NEP) 2020**

Master of Science (Botany)	Semester I
Course Code	DSC-I
Course Name	Phycology, Mycology and Bryophytes
Course Credit	04 + 02 (06)
Course working Hours	60 Hrs (L)
Course Structure	Theory and Practicals

Course Description: The course includes diversity distinct characters life cycles, economic and ecological importance of algae, fungi and bryophytes.

Course Objectives: The purpose of this syllabus is to understanding knowledge about identifying lower cryptogams and Microbes. To develop skill in identifying microbial cultures and their preservation. To familiarize the students about distinctive diversity of algae, fungi and bryophytes.

Course learning outcomes: This course will enable students to know the lower plants, their vegetative structures and their importance. From this course student will gain the knowledge of classification by using certain key characters. They will also understand morphological, anatomical, and reproductive structure of lower group of plants such as algae, fungi and bryophytes. Students will develop basic skill in handling, sectioning and culturing of algae and fungi. Gain practical knowledge of preparing various microbial cultures and identifying them.

Unit I :Phycology (15 hours)

1.1 Recent classification, Contribution of algal studies in India.

1.2 Thallus organization, Origin and evolution of sex.

1.3 **Study of the structure and life cycle of the following Algae**

Cyanophyceae: *Oscillatoria*. **Chlorophyceae:** *Volvox* **Charophyceae:** *Nitella*

Bacillariophyceae: *Navicula* **Ulvophyceae:** *Ulva* **Phaeophyceae:** *Sargassum*.

Rhodophyceae: *Gracilaria* **Euglenophyceae:** *Euglena*.

1.4 Laboratory techniques of culturing algae, mass-cultivation and method of preservation of algae. Useful and hazardous effect of algae.

ModuleII: Mycology (15 hours)

2.1. Recent classification, Reproduction in fungi, Research work in the field of mycology.

2.2 Heterothallism and parasexuality in fungi, General characters of slime mould. Fossil fungi.

2.3 General characters and life cycle of *Cunninghamella*, *Penicillium*. *Alternaria*, *Pleurotus*. Deterioration of materials by fungi, Fungi as agents of plant and human diseases.

2.4 Structure and life cycle of Mushrooms, Economic importance of Mushrooms.

Module III: Plant pathology (15 hours)

3.1 Introduction, History and Principle of plant pathology. Host-parasite interaction. Methods of study of disease of plant, isolation of pathogens and tests of pathogenecity.

3.2 Causal organism, Symptoms, Disease Cycle and Control measures of the following fungal Diseases, Foot rot of wheat, Downey mildew, Rust on plants, Mango abnormalities

3.3 Causal organism, Symptoms, Disease Cycle and Control measures of the following bacterial diseases on different crops: Tundu disease of wheat, stalk rot of maize, Fire blight of apple.

3.4 Causal organism, Symptoms, Disease Cycle and Control measures of the following viral diseases on different crops Bunchy top of Banana, Mosaic of Cucurbits.

Module IV: Bryophyta

(15 hours)

- 4.1 Distribution, Recent system of classification, Ecology of Bryophytes.
- 4.2 Fossil history of bryophytes, Evolution of sporophyte-Retrogressive and Progressive Contributions of Indian Bryologists
- 4.3 General characters, distribution, structure and reproduction in Marchantiales (*Plagiochasma*, *Lunularia*), Porellales (*Porella*), Sphaerocarpaceae (*sphaerocarpos*), Takakiales (*Takakia*), Anthocerotales (*Anthoceros*), Sphagnales (*Sphagnum*) Polytrichales (*Polytrichum*).
- 4.4 Ecology and economic importance of bryophytes with special reference of *sphagnum* Bryophytes as indicators of water and air pollution. Level of threat and need of conservation in bryophytes.

Practicals of (Phycology, Mycology and Bryophyta) Total 30 hours

Phycology practicals

(10 hours)

1. Microscopic study of following examples of classes:

Cyanophyceae: *Microcystis*, *Lyngbya*, *Gloeotrichia*, *Oscillatoria* Chlorophyceae: *Pandorina*, *Eudorina*, *Chlorella*, *Scenedesmus*, *Caulerpa*, *Acetabularia*, *Hydrodictyon* Charophyceae: *Nitella*
Bacillariophyceae: *Navicula* *Cymbella*, *Gomphonema*, *Pinnularia* Ulvophyceae: *Ulva*

Phaeophyceae: *Sargassum*, *Laminaria* *Padina*, *Turbinaria*; Rhodophyceae: *Gelidium*, *Gracilaria*, *Corallina*, *Polysiphonia*, Euglenophyceae: *Euglena*, *Phacus*.

2. Culturing techniques of Algae

3. Herbarium techniques in Algae

4. **Field study:** Collection and study of various forms of algae collected from the pond site or river site area and prepare a report and submit.

Practicals of Mycology and Plant Pathology

(10 hours)

1. Morphological Studies of Fungi:

Phytophthora, *Chaetomium*, *Erisyphe*, *Phyllactinia*, *Uncinula*, , *Melampsora*. *Xylaria*

2. To Study structure and morphology of Mushrooms.

Ganoderma, *Pleurotus*, *Agaricus*, *Auricularia*.

3. To study the symptoms of some diseased plants.

Downy mildew, Powdery mildew, Rusts, smuts, Ergot, False smut of paddy, wilt disease, Leaf mosaic of papaya, Leaf curl of tomato/potato, Little leaf of brinjal.

4. Sterilization techniques and Preparation of media for isolation of fungi.

5. To study the Macroscopic and Microscopic study of fungi by using following fungal cultures. (Any 5)

Mucor, *Rhizopus*, *Aspergillus*, *Penicillium*, *Drechslera*, *Curvularia*, *Alternaria*, *Bipolaris*.

6. Field study for collection of fungal flora and prepare a field report by using certain infections.

Practicals of Bryophyta:

(10 hours)

1. Study of morphological and reproductive characters of bryophytes (Any seven) *Riccia*, *Plagiochasma*, *Targionia*, *Fimbriaria*, *Lunularia*, *Porella*, *Anthoceros*, *Sphagnum* and *Polytrichum*.
2. Preparation of permanent slides by using bryophytic materials.
3. Study of bryophytes in their natural habitats.
4. Preservation techniques used for bryophytic material (Double staining method).
5. Botanical excursion outside the state is compulsory to study the bryophytes

6. Herbarium techniques for Bryophytic materials.

Suggested Readings

1. Anantnarayan and Panikar. Textbook of Microbiology. Orient Longman Private Limited, 2007.
2. Aneja and Jain. A Textbook of Basic and Applied Microbiology. New Age International Pub- lisher, 2008.
3. Arumugam and Kumarsan. Biotechniques. Saras Publication, Nagargoil, 2015.
4. Atlas. Microbiology Fundamentals and Application. Macmillan Publishing Company, 1989.
5. Baveja.C.P. Textbook of Microbiology. 6th. Microbiology. Arya Publication, 2018.
6. Bendre and Pande. Introductory Botany. Rastogi Publication, Gangotri, 2011.
7. Kar, Ganguly and Santra. College botany. New Central book agency, Kolkatta. 2011.
8. Bhattacharya ,Ghosh and Hait. A Textbook of botany. New central book agency. Kolkatta, 2019.
9. G. Hait. A Textbook of Microbiology. Kolkata: New Central Book Agency, 2016.
10. I. Kaur. Textbook of Fungi. Delhi: Macmillan Publisher India, 2011.
11. S. Kumar. Diversity of Algae, Lichen and Bryophytes. Prakashan Prakashan, Meerut, 2015.
12. R.S. Mehrotra and A. Agrawal. Plant Pathology. Mcgraw Hill Publications, Chennai, 2017.
13. H. Modi. A Handbook of Elementary Microbiology. Shanti Prakashan, Delhi, 2017.
14. P. Modi. Notebook's of Microbiology. 2nd. CBS Publisher Distributor PVT Limited, 2017.
15. A. Kumarsen Regland. Algae, Fungi. Bryophytes and Plant Pathology. Saras publication, Nagargoil, 2014.
16. P.D. Sharma. Plant Pathology. Narosa Printing House Pvt, Ltd. New Delhi, 2006.
17. Sinha and Shrivastava. An Introduction to bacteria. Vikas Publishing House Pvt Ltd, New Delhi. 1995.
18. G. Sumbali. The Fungi. 2nd. Narosa Publishing house.
19. Tembhare. Techniques in Life Sciences. Mumbai: Himalaya Publishing House Pvt Limited, 2008.

Suggested URLs/Websites:

- <https://msafungi.org/>
- <https://nptel.ac.in/content/storage2/courses/102103044/pdf/mod3.pdf>
- http://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S001174BS/P001204/M011034/ET/1479290706P9M11eTextAug13.pdf

Master of Science (Botany)	Semester I
Course Code	DSC-II
Course Name	Pteridophytes, Paleobotany and Gymnosperms
Course Credit	04 + 02 (06)
Course working Hours	60 Hrs (L)
Course Structure	Theory and Practicals

Course Description: To acquaint the students about different pteridophytic, gymnospermic flora.

Course Objectives: This course aims to prepare understanding of evolutionary diversification of early land plants also their histories. The course aims to distinguish morphological, anatomical and reproductive variations in pteridophytic, gymnospermic plants

Course learning outcomes: Students will compare and describe General Characters, classification system, distribution of pteridophytes, gymnosperms and fossil history of both.

Unit I : Pteridophytes [15Hrs.]

- 1.1 Classification (recent), Stellar evolution
- 1.2 Comparative morphology, structure, developmental stages of the following groups:
Psilopsida (Rhynia, Psilotum)
- 1.3 Comparative morphology, structure, developmental stages of the following groups: Lycopsidea (Lepidodendron , Lycopodium)
- 1.4 Comparative morphology, structure, developmental stages of the following groups: Sphenopsida (Calamitis, Equisetum)

Unit II : Pteridophytes Contd. [15Hrs.]

- 2.1 Comparative morphology, structure, developmental stages of the following groups: Pteropsida (Pteris, Dryopteris)
- 2.2 Study life cycle and developmental stages of the following groups: Ophioglossum, Osmunda, Marsilea , Azolla, Gleichenia
- 2.3 Endangered and endemic pteridophytes and their conservation
- 2.4 Cultivation and maintenance of ferns

Unit III : Paleobotany and Gymnosperms [15Hrs.]

- 3.1 Introduction of plant fossils, Plant fossils - Theories of preservation, preparation, age determination, geological time scale
- 3.2 Fossil record: Systematic, reconstruction and nomenclature, applied aspects of paleobotany
- 3.3 Cycadeoidales- Williamoniaceae - Williamsonia, Cycadeoidaceae – Cycadeoidea
- 3.4. General characters and recent systems of classification of gymnosperms, Economic Importance of Gymnosperms.

Unit IV : Paleobotany and Gymnosperms contd. [15Hrs.]

- 4.1 General account and relationships of- Pentoxylales, Gnetales, Ephedrales, Ginkgoales
- 4.2 Comparative morphology and evolutionary tendencies of: Cordaitales, Caytoniales, Glossopteridales
- 4.3 Pteridospermales- Lyginopteridaceae - *Lyginopteris old-hamiae* (*Colymototheca hoeninghausii*), & *Heterangium*; Medullosaceae - *Medullosa*
- 4.4 Coniferales - General characters, Embryogeny and phylogeny, evolution of ovuliferous scales, phylogeny,

Practicals :**Pteridophytes :**

1. Study of fossil forms (Specimens and permanent micropreparations) : (Rhynia, Lepidodendron, Calamites)
2. Study of living forms : Morphological, Anatomical and reproductive characters of Psilotum, Lycopodium, Equisetum, Ophioglossum, Osmunda, Marsilea, Azolla, Gleichenia, Pteris , Dryopteris

Paleobotany and Gymnosperms :

1. Comparative Study of vegetative and reproductive parts of: *Cycas, Zamia, Cedrus, Pinus, Cupressus, Cryptomeria, Taxodium, Podocarpus, Thuja, Gnetum, Ephedra, Juniperus, Cephalotaxus, Taxus, Ginkgo*: Morphology to be studied from Museum specimens anatomy from permanent slides only.
2. Permanent micropreparations to be submitted by the students.
3. Study of important fossil gymnosperms from material and permanent slides.
4. Visit to paleobotanical institutes, localities and collection of specimens.
5. Field visits to ecologically different localities to study living gymnosperms.

Suggested readings:

1. Vasishta P.C. (1974). Botany for degree students, Vol. 4 : vascular cryptogams (pteridophyta). S. Chand Co., New Delhi
2. Sporne K.R. (1966). Morphology of pteridophytes, the structure of ferns and allied topics.
3. Samuel.W.B. (1984). Selected ferns and lycopods. Ajay Book Service, New Delhi Hutchinson.
4. Arnold, C. A. (1947). An introduction to paleobotany. McGraw-Hill Book Company. New York.
5. Holt, Rinehart Winston. (1966). Morphology and evolution of fossil plants. Springer, USA
6. Mishra, S.R. (2010). Text Book of palaeobotany. Discovery Publishing Pvt.Ltd. New Delhi.
7. Sambamurty (2006). A textbook of bryophytes, pteridophytes, gymnosperms and paleobotany. I.K.International Pvt. Ltd. New Delhi.
8. Shukla, A.C. Misra, S.P. (1975). Essentials of paleobotany. Vikas Publishing house pvt. Ltd. Delhi
9. Stewart, W. N., Stewart, W. M., Rothwell, G. W. (2005). Paleobotany and the evolution of plants. Cambridge University Press.
10. Sharma O.P. (1999) Gymnosperms. Pragati Prakashan, Meerut
11. Coulter John M. (1964). Morphology of gymnosperms. Central Book Depot, Allahabad
12. Sporne K.R. (1967). Morphology of gymnosperms: structure and evolution of primitive seed-plants. Hutchinson Co. (Publishers) Ltd., London

Suggested URLs/Websites:

- <http://www.jnpg.org.in/WebDoc/EContent/science/General%20characters%20of%20Pteridophytes.pdf>

Master of Science (Botany)	Semester I
Course Code	DSE-I
Course Name	Tools and Techniques
Course Credit	04 + 02 (06)
Course working Hours	60 Hrs (L)
Course Structure	Theory and Practicals

Course Description:

This course offers a comprehensive exploration of essential tools and techniques used in the field of botany. Through a balanced combination of theoretical understanding and hands-on practical experience, students will gain proficiency in various laboratory methodologies and analytical approaches commonly employed in plant research. The course is designed to equip students with the foundational knowledge and skills necessary to conduct experiments, analyze plant specimens, and interpret experimental results.

Course Objectives:

1. Gain a comprehensive understanding of the SI system of measurement, fundamental and derived units, and apply this knowledge to make accurate solutions with specific concentrations.
2. Understand the principles of microscopy, including light microscopy, fluorescence microscopy, and confocal microscopy.
3. Develop competency in techniques such as centrifugation, both differential and density gradient, for cell fractionation.
4. Acquire skills in working with radioisotopes, including the calculation of half-life and specific activity, and learn to measure radioactivity using various radiation counters and scintillation counters.
5. Understand principles of chromatography and Gain hands-on experience in a range of chromatography techniques, including paper chromatography, column chromatography, TLC, GLC, and HPLC.

Course learning outcomes: The course will enable students to demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization in biology.

Unit I: Biochemical solutions and enzyme studies

[15Hrs.]

- 1.1 SI System of measurement: Fundamental and derived units.
- 1.2 Making solutions: Moles and molarity, stock solutions and dilutions, making media and reaction mixtures, pH measurements and preparation of buffers
- 1.3 Enzymology: Classification and properties of enzymes, coupled reactions, units of enzyme activity. Enzyme kinetics – substrate concentration and rate ; Km. Factors affecting enzyme activity. Rate kinetics
- 1.4 Electrochemical techniques: Construction and working of equipments for measurement of electrical conductivity, pH meter.

Unit II: Imaging and related techniques

[15 Hrs.]

- 2.1 Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy.
- 2.2 Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy:
- 2.3 Chromosome banding, FISH.
- 2.4 Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit III: Cell fractionation, Radioisotopes and Spectrometry

[15 Hrs.]

- 3.1 Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl₂ gradient.
- 3.2 Radioactive techniques: Isotopes and their half-life, Specific activity of radioisotopes, making radioisotope solutions, detection and measurement of radioactivity - radiation counters, liquid scintillation counters, autoradiography. Use of Radioisotopes in biological research,
- 3.3 UV- Vis Spectroscopy, IR Spectroscopy, Raman Spectroscopy - Principle and application in biological research.
- 3.4 NMR Spectroscopy, Mass Spectroscopy - Principle and application in biological research.

Unit IV: Chromatography and Characterization of proteins and nucleic acids [15 Hrs.]

- 4.1 Principle - Paper chromatography; Column chromatography; TLC; GLC; HPLC.
- 4.2 Principle - Ion-exchange chromatography; Affinity chromatography.
- 4.3 X-ray diffraction; X-ray crystallography
- 4.4 Characterization of proteins and nucleic acids – Electrophoresis; AGE, SDS-PAGE.

Practicals:

[30 Hrs.]

1. Practical on centrifugation- To convert rpm to g when using centrifuge with different rotors. - Transferring centrifugation parameter
2. Problems based on half life of radioisotopes (5 examples)[If 50.0 mg of iodine-131 was injected for medical treatment, how many milligrams will be left after 40.5 days? (Half-life of iodine-131 is 8.1 days)]
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker DNA) using agarose gel electrophoresis
10. Preparation of solutions of different concentrations.
11. Conductivity and pH measurements.
12. Determination of pKa values and buffering capacity of acetate buffers
13. Absorption spectra of BSA / DNA and determination of absorption maxima, molar extinction coefficient
14. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence, and FISH).
15. Effect of pH, temperature, concentration of enzyme on invertase activity, Effect of substrate concentration on invertase activity

Suggested Readings:

Arumugam N and Kumaresan V (2021) Biotechniques. Saras Publishers, India

Rana S V S (2019) Biotechniques- Theory and Practice , Rastogi Publishers, India

Master of Science (Botany)	Semester I
Course Code	RM
Course Name	Research Methodology
Course Credit	04 + 02 (06)
Course working Hours	60 Hrs (L)
Course Structure	Theory and Practicals

Course Objectives:

1. Gain a comprehensive understanding of research methodology and its fundamental concepts.
2. Develop the ability to critically evaluate and select appropriate research methods for different types of research.
3. Acquire skills in data collection, analysis, and interpretation using various statistical techniques.
4. Enhance proficiency in technical writing, research reporting, and adherence to research ethics and academic integrity.

Course Outcomes:

After learning research methodology course, students will be able to

1. Identify and describe the characteristics of different types of research, including basic, applied, and patent-oriented research.
2. Apply scientific thinking and problem identification techniques in the research process.
3. Apply descriptive and inferential statistical analysis techniques to analyze and interpret research data and understand the concept of hypothesis and its importance in research, and apply appropriate research methods.
4. Develop skills in technical writing, research reporting, and the proper structure and organization of research documents and gain awareness of research ethics, academic integrity, and the importance of avoiding plagiarism and academic malpractice.

Syllabus

Unit 1: Research basics and perception of research [15Hrs.]

- 1.1 Definition, General and specific characteristics of research, types of research (basic, applied and patent oriented).
- 1.2 Steps of Action (basic) research, objectives of basic research, characteristics of investigators.
- 1.3 Scientific thinking- characters, steps in process of scientific thinking, Steps in problem identification, criteria for selecting problem, and sources of scientific problems.
- 1.4 Review of literature- meaning, need, and objectives, structure of review of literature, sources of literature collection, Simple rules of structuring (writing) literature review.

Unit 2: Basics of hypothesis, research methods,

Data collection, tables, and graphs [15Hrs.]

- 2.1 Definition of hypothesis, assumption, and postulate, nature, function and importance of hypothesis, characteristics of good hypothesis
- 2.2 Definition and types of research methods, characteristics of survey methods, Types of survey methods and their advantages

- 2.3 Experimental method- definition, basic assumption, Types of variables (controls) in experiments, Steps of experimental methods, Case study method, laboratory records and its importance, Ethics and safety of laboratory or work place
- 2.4 Types of data (variables): Nominal variable, Ordinal or rank variable, interval and ratio variable, analysis of data: Descriptive and inferential, Meaning of parameters, sample, populations, Basic structure of Graph, Bar graph, pie chart, Line graph, Basic structure of table, Meaningful tables

Unit 3: Statistical analysis [15Hrs.]

- 3.1 Concept of central tendency of data, Median, Mode, Mean (and types of means), Merits, and demerits of using different measures & their applicability
- 3.2 Concept of dispersion(variability): Range, Standard deviation, standard errors, merits, and demerits of measures, tables and graphs showing descriptive measures
- 3.3 Hypothesis, Procedure for hypothesis testing, Z test, one tailed and two tailed student's t test, one sample t test, two sample t test,
- 3.4 chi-square test, one way ANOVA, Structure of ANOVA table, Relation between regression coefficients and correlation coefficient

Unit 4: Technical, and research reporting, research ethics and plagiarism [15Hrs.]

- 4.1 Research report- need of research report, General format of research report, Essential steps for writing scientific manuscript/research paper.
- 4.2 Types of reports: Structure of thesis, structure of research paper, structure of project report, structure of project proposal
- 4.3 Annotated bibliographies: Structure and organization, Critical thinking, Evaluating information
- 4.4 Academic integrity, skills (rules) for good academic practice, understanding plagiarism and academic malpractice

References/ Books:

- Shanti Mishra, & Alok, S. (2011). *Handbook of Research Methodology: A Compendium for Scholars & Researchers*. Educreation Publishing.
- Singh, Y. kumar. (2006). *Fundamentals of Research Methodology and Statistics*. New Age International Publishers.
- Walliman, N. (2010). *Research Methods The Basics*. Routledge Taylor and Francis Group.

Assignments based on Research Methodology course

Instructions:

These assignments can enhance the professional skills needed to pursue a career in research/teaching. Therefore, each PG department should identify ten assignments from the list below. Continuous evaluation will occur throughout the semester. Performance on the assignment will be graded for 40 marks.

1. **Navigate and use Google, Google Scholar, SciHub, PubMed, Web of Science, Elicit and ScienceDirect effectively to search for research papers, perform searches and retrieve relevant research papers.**

[Suggestion/Working hours:- Dedicate a few hours each week to practice searching on these databases to continually refine your skills.]

2. **Write accurately references in APA format for various types of sources, including books, journal articles, websites, and conference papers and gain a comprehensive understanding of the Zotero platform, including its interface, features, and capabilities for managing bibliographic information.**
[Suggestion/Working hours- Invest time in exploring and understanding the features of Zotero(<https://www.zotero.org/>) through guided tutorials and hands-on experience and gain proficiency in using Zotero to input, organize, and format references, and effectively manage bibliographic data]
3. **How to read research paper and develop a thorough understanding of the three-pass approach for effective note-taking from research readings.**
4. **Review and analyse collected references systematically to identify at least three prospective research problems or gaps in your domain.**
[Suggestion/Working hours:- Review a minimum of 20 relevant references in your domain to gain a comprehensive understanding of current research trends and gaps. Dedicate focused time each week to systematically review references and refine your problem identification skill]
5. **Write at least three research objectives and three hypotheses that are well-defined, focused, and aligned with the research problem.**
[Suggestion/Working hours:- Within one month, be able to formulate clear and relevant research objectives or hypotheses for the given research problem. Seek feedback from mentors or advisors to refine your research objectives or hypotheses and ensure their relevance and clarity.]
6. **Identify and differentiate between independent, dependent, and controlled variables in both laboratory and field experiments and thoroughly explore experimental setups, techniques, and equipment required for conducting both laboratory-based and field-based experiments based on the given research objectives.**
7. **Write logbook records accurately for laboratory activities, experiments, and observations. Familiarize yourself with the structure and components of a laboratory logbook, including sections for dates, experimental procedures, observations, results, and signatures.**
[Suggestion/Working hours:- Dedicate time each week to review and improve your logbook records based on feedback and personal assessment.]
8. **Prepare excel templates for curating data by converting raw data into final values or observation. Prepare final data sets for graphs and prepare descriptive statistics measures.**
9. **Create a graph (line/bar/pie) using Microsoft Excel. Prepare publication ready graph and write legend for the graph and table.**

- 10. Conduct t-test/ANOVA and present results in table and in graph.**
- 11. Understand structure of scientific poster. Write well-structured scientific poster that effectively communicates research findings, adheres to design principles, and captures audience attention.**
- 12. Understand structure of oral presentation and demonstrate the ability to deliver a clear and engaging oral presentation, incorporating effective communication techniques, and supporting visual aids.**
- 13. Find out how to use the chosen plagiarism detection tool step by step to check a paper for possible instances of plagiarism. Attain the ability to use the chosen plagiarism detection tool proficiently, including uploading documents, interpreting plagiarism reports, and understanding similarity scores.**
- 14. Write one page research proposal. Write research proposal in the format of any funding agency.**
- 15. Write minireview article.**
- 16. Write short communication with one table and one figure.**
- 17. Write scientific blog.**

Master of Science (Botany)

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Course Structure

Semester I

DSC-II

Pteridophytes, Paleobotany and Gymnosperms

04 + 02 (06)

60 Hrs (L)

Theory and Practicals