

**Programme Outcome and Programme Specific Outcome
Subject Botany**

POST-GRADUATION COURSES

A. M.Sc. 1st Year:

M Sc Botany program is designed with an objective to encourage and support the growing demands and challenging trends in the educational scenario. Our training focuses on the allround development of the students to face the competitive World.

OBJECTIVES OF THE M SC BOTANY PROGRAMME:

1. Understand the scope and significance of the discipline.
2. Imbibe love and curiosity towards nature through the living plants.
3. In order to make students open-minded and curious, we try our best to enhance and develop a scientific attitude.
4. We make the students fit for the society by enabling them to work hard.
5. Make the students exposed to the diverse life forms.
6. Make them skilled in practical work, experiments, laboratory equipment and to interpret correctly on biological materials and data.
7. Develop interest in Biological research.
8. Encourage the students to do research in related disciplines.
9. Develop a thirst to preserve the natural resources and environment.
10. Develop the ability for the application of acquired knowledge in various fields of life so as to make our country self-sufficient
11. Appreciate and apply ethical principles to biological science research and studies

PROGRAM SPECIFIC OUTCOMES (PSO) OF MSc BOTANY:

Plant science is now an amalgamation of basic and applied science. Plants besides being the unique capability of plants to trap solar energy and provide food to all cannot be replicated by any system. Conventional studies like plant identification are now being supplemented with molecular techniques like DNA Barcoding. The courses have been designed to benefit all Botany students to study various aspects of plant science including its practical applications. Keeping in mind that these students can take up teaching at different levels, research work in research institutes and or industry, doctoral work, environment impact assessment, biodiversity studies, entrepreneurship, scientific writing relevant topics have been included in the curriculum.

PSO 1: Understanding the classification of plants from cryptogams to Spermatophyte. Identification of the flora within field enhances basics of plants. Study of biodiversity in relation to habitat will correlates with climate change, land and forest degradation. Application of Botany in agriculture is through study of plant pathology.

PSO 2: Understand the ultra structure and function of cell membranes, cell communications, signaling, genetics, anatomy, taxonomy, ecology and plant Physiology and biochemistry. To understand the multi functionality of plant cells in production of fine chemicals and their wide spread industrial applications.

PSO 3: Molecular and Physiological adaptations in plants in response to biotic and abiotic stress. Genes responsible for stress tolerance genetic engineering of plants.

Semester I

BOUT 111: Botany Theory Paper I-Plant Systematics I

Algae

1. Taxonomy is involved in description, identifying; nomenclature & classification of plants whereas Systematics deals with evolutionary or phylogenetic, relationships among plants.
2. In practice both terms are used interchangeably. Also with advent of genetics, molecular biology & DNA research approach to classification has changed significantly. This concept has to be very clear for post graduate students.
3. Cryptogams are classified as : Kingdom Eubacteria (Cyanophyta) ; Kingdom Protista (Slime molds & Chlorophyta upto Rhodophyta) ; Kingdom Fungi (Phycomycetes upto Deuteromycetes & Lichens) ; Kingdom Plantae (Bryophyte & Pteridophyte). Students should understand that in contemporary plant systematics Cryptogams not a taxonomically coherent group but is cladistically polyphyletic.
4. All known Cryptogams belong to field traditionally studied by Botanists & names of all are regulated by International Code of Botanical Nomenclature.
5. Cryptogams have an important role & function in bioprospecting. The vast majority of earth's species are microbial & less than 1% of all species described have been studied beyond SIMPLY NOTING THEIR EXISTENCE.
6. Algae, Fungi along with Bryophyte & Pteridophyte have many ecological, economic & industrial applications which can be grasped by students only if they are well studied in detail in theory & practicals.
7. The proper understanding will facilitate efforts on research and development directed on the Cryptogams.
8. Algal research covers all areas of emerging technologies in algal biology, biomass production, cultivation, harvesting, extraction, bio products, bio refinery, etc.

Fungi:

1. The students will learn about the fungi as an organism, its position in the various kingdoms, basics of various aspects like thallus structure, nutrition etc.
2. They will learn about then widely accepted classification system of Ainsworth et al. (1973)
3. Similarly the students will study the characters, thallus structure, reproduction and life cycle of different classes like Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.
4. The students will also get aware about the applies aspects of fungi in Biofertilizers, biocotrol, food and medicine.

BOUT 112: Botany Theory Paper II- Cell Biology

With the studying Cell Biology, students will know about the cell and its biology.

Cell Biology study which will help the students to understand the origins of cells and the generation of cell diversity, as well as the common features of cellular structure and function even they know about how they obtain energy, synthesize new molecules, communication between two cells, proliferate and survive.

Students also learns about different cellular processes like Cell cycle and its regulations, Programmed cell death as well as responses against environmental stress.

In cell biology they know about genome composition of different organisms.

Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles.

Students will understand the cellular components underlying mitotic cell division.

BOUT 113: Botany Theory Paper III-Cytogenetics, plant breeding and evolution

1. cytogenetic credit permitting the students for differentiation of a greater number of Chromosomal abnormalities

2. students will learn the basics of Chromosome nomenclature and it will be helpful for further research.

BODT 114: Botany Theory paper 4- Pomoculture and Fruit Processing Technology

The course would enable student to learn technical knowhow in Pomoculture and Processing of post harvest produce.

This will also help in creating awareness about how to control wastage of fruits after excess production

Semester II

BOUT 121: Botany Theory Paper 1- Plant Systematics II

BOUT 122: Botany Theory Paper II- Molecular Biology

1. Molecular biology study gives in-depth knowledge of biological and medicinal processes through the investigation of the underlying molecular mechanisms to students.

2. In this subject student will understand the cell at molecular level, their genome content as well as how the processes like how replication of DNA occurred? How transcription and translation were occurred in cell?

3. Students will gain an understanding of chemical and molecular processes that occur in and between cells. Your understanding will become such that you will be able to describe and explain processes and their meaning for the characteristics of living organisms.

4. Students will gain insight into the most significant molecular and cell-based methods used today to expand our understanding of biology.

5. Various techniques has been included to increase the skill of students in molecular biology.

BOUT 123: Botany Theory Paper III- Biochemistry

BODT 124: Botany Theory paper 4- Mushroom cultivation and Bio-pesticides

Credit I: Mushroom Cultivation

1. The students will learn about the history of mushroom culture, scope and present status of mushroom cultivation in India and other parts of the world.

2. They will also learn about different types of edible and poisonous mushrooms, nutritional and medicinal benefits of mushrooms.

3. They will learn to prepare spawn, spawning, running and cropping.

4. The students will learn about cultivation of mushrooms like *Volvariella*, *Lentinus*, *Pleurotus* and *Agaricus*, their crop and pest management.

5. Students will learn about different delicious recipes of mushrooms and commerce of mushroom industry.

6. By learning, the students will be train to start her own small scale industry, spawn production laboratory, consultancy.

Credit II: Bio-pesticides

1. Students will study that Industrial algal technology has wide applications in food & feed supplies, pharmaceuticals & nutraceuticals, bio fertilisers, biofuels & fine chemicals

2. They will learn Importance of herbal origin of biopesticides has & students have to focus on improving health, enhance environmental protection.

3. Students learn Methodology & Research to develop cheap & effective techniques for environmentally sound technologies.

B. M.Sc. IInd Year:

BO. 3.1. Spermatophytic Botany

1. Be able to use the proper terminology for vegetative and reproductive features that are used in the identification of vascular plants.
2. Learn how to use published keys for the identification of flowering plants
3. Learn to recognize some common plant families of SW Colorado
4. Learn to use the proper scientific names for plant groups.
5. Gain an understanding of the relationships between evolutionary history and plant classifications.
6. Demonstrate basic knowledge and skill in using bioinformatics associated with biodiversity research
7. Develop an ability to interpret research findings in Systematic Botany and understand how those findings contribute to the changes seen in nomenclature, the botanical classification systems, and for understanding evolutionary patterns.
8. Learn how to utilize the basic research methods used in modern systematic biology.

BO. 3.2. Developmental and Economic botany

1. In development botany, the students will learn about basic process of plant development, factors affecting development, growth and development of plant embryo and seed.
2. They will also learn about developmental process of vegetative shoot to flowering shoot, male and female gametophyte and organ development, various aspects of embryo development including polyembryony.
3. In this credit the students will learn about physiological and molecular aspect of plant development, various genes involved in leaf, stem, root, flower, embryo development, role of organ culture, anther, pollen and protoplast culture and its role in understanding plant development.
4. The students will also deal with applied aspect such as cell lineages, cell fate mapping, positional informational techniques for studying development.
5. This knowledge will help students to undertake research in the field of developmental biology.

BO. 3.3. Industrial Botany 60 L

Algal Technology (1 Credit)

1. It is the promising future of micro algae and challenges of a sustainable and renewable industry for biofuels, food and other products
2. Micro algae have interest due to their extensive application in biopharmaceutical and nutraceuticals industry.
3. Algae have importance in conversion of CO₂ into food products.

Biofuel and Biopesticide (1 Credit)

1. Industrial algal technology has wide applications in food & feed supplies, pharmaceuticals & nutraceuticals, bio fertilisers, biofuels & fine chemicals
2. Importance of herbal origin biopesticides have to be emphasised & students have to focus on improving health, enhance environmental protection.
3. Methodology & Research to develop cheap & effective techniques for environmentally sound technologies.
4. Integrated Approach for environmental management is essential.
5. The renewable energy sources are important now a days so biofuel industries have been established by using living organisms.

6. The energy content of biodiesel is about 90% and that of petroleum diesel. Hence, study of biofuels has received importance.
7. In order to save the biodiversity and indigenous cropping pattern' use of biopesticides is always helpful rather than chemical pesticides.
8. Study of biopesticides and their manufacturing is possible with the help of this knowledge.
9. A student of botany will be a good entrepreneur.
10. Algal fuels a IIIrd generation biofuels are a source of energy rich oils & can replace fossil fuels. Lipid part of algae biomass can be extracted & converted into biodiesel. Alternatively or following lipid extraction, the carbohydrates content of algae can be fermented into biobutanol.
11. Bio hydrogen a IVth generation biofuel likely to involve harvesting of solar energy with practical technologies yet to be developed .
12. Proper understanding will facilitate efforts on research & development directed towards Botany Entrepreneurship and Management (1 Credit)
 1. Students will plan, conduct an independent project.
 2. It provides the cutting –edge knowledge and skills on how to successfully develops products from plant parts.
 3. A student will be able to apply the skills of development in the context of new ventures as well as in established companies.

Fermentation Technology (1 Credit)

Fermentation Technology (1 Credit)

1. It describes the characteristics of condition required the fermentation processes.
2. It gives the role of microorganisms in fermentation.

Learning of fermented food products like cheese, butter, bread, wine, alcohol etc.

BO 3.46. Advanced Medicinal Botany

The student should on completion of the course, advanced medicinal botany they are able to know the knowledge of plants used as medicine.

Students who study medicinal botany they study historical perspective as well as scope of herbal medicine, trade in medicinal plants etc.

The study of medicinal botany gives an idea about Drug adulteration, how to evaluate herbal drug and their purity, how to check quality of herbal drug as well as to study different plant drug and plant tissue culture study with respected to phytopharmaceuticals, etc.

M.Sc. Botany Semester IV

BO 4.1. Computational Botany

1. Discuss the mathematical basis and foundations of probability and statistics
2. Explain and apply the fundamentals of applied statistical methodology
3. Effectively communicate the results of a statistical analysis
4. Use of Biostatistics in Layout and Design of Experimental Plots

Program outcome:

1. Perform computational analyses of biological datasets and relate the results to core principles in biology.
2. Use computational methods to help execute a biological research plan.
3. Analyze biological problems from global and ethical impact perspectives (impact of computational biology methods).

BO 4.2. Plant Organism Interaction

1. In this subject student studies Plant Interactions with Other Organisms. It is the study of interactions of organisms with one another as well as with their environment. Plants, with their sedentary existence and need to attract pollinators or prevent herbivores from consuming them have evolved a different set of behaviour patterns than have animals.

2. In this section Competition results when an individual plant interferes with the needs of another plant for the same environmental resource such as light, minerals, space or when members of one population interfere with members of another for the same environmental resource. In plants, competition generally is indirect, through the resource, not direct, one-on-one. Plants with the same life form and growth requirements are often in competition but surviving in slightly different microenvironments.

3. In Allelopathy study learning the particular form of direct competition in which one plant produces a substance toxic to another. In some instances, the substance inhibits the development of the producer's own seeds or spores.

4. In a symbiosis, two different kinds of organisms live together in an intimate and more or less permanent relationship. In this students will studied Lichens, Mycorrhizae, etc.

BO 4.3. Industrial Botany II (4 Credit) 60 L

Herbal Technology (1 Credit)

Post Harvest Technology (1 Credit)

Gardening and Forest Botany (1Credit)

Industrial Plant Tissue Culture (1 Credit)

BO 4.4. Plant Pathology

1. The students will get introduced to plant pathology, history and objectives, concept of plant disease, classification, causes, plant disease epidemiology and forecasting. The students will also learn about various Bacterial, mollicutes, viral and Nematode diseases of plants.

2. The students will also learn about various stages of infection, effect of pathogens on plant physiology, the enzymes and toxins involved in disease development.

3. Applied aspects such as effect of environmental factors on disease development, genetics of plant pathogen interaction, plant defense mechanism, molecular aspects of host pathogen interaction and post-harvest diseases of fruits, vegetables and seeds will be learn by the students.

4. Where as in disease management and related aspectthe students will learn about detection of pathogene, breeding to improve crop, chemical and bio-control, disease assessment.

5. The student will then enable to do research in the field of plant pathology, may have the consultancy.

BO 4.6. Research Methodology and Summer Training (4 Credits)