



शिवाजी कॉलेज  
(दिल्ली विश्वविद्यालय)  
*Shivaji College*  
(University of Delhi)



NAAC ACCREDITED "A" GRADE COLLEGE

## Bachelor of Science (Hons.) Botany

### PROGRAMME LEARNING OUTCOME

The course learning outcomes are aligned with program learning outcomes but these are specific-to-specific courses offered in a program. The course level learning shall be reflected as program level learning. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with multi-dimensional and multidisciplinary approach.

1. Understanding of plant classification systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms. Understanding of various analytical techniques of plant sciences, use of plants as industrial resources or as human livelihood support system and is well versed with the use of transgenic technologies for basic and applied research in plants.
2. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.

### COURSE LEARNING OUTCOMES

1. Students will be able to understand and explain different specializations of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, cell and molecular biology of plants.
2. Students will be trained in various analytical techniques of plant biology, use of plants as industrial resources or as support system for human livelihood and will be well versed with the use of transgenic technologies for both basic and applied research in plants.
3. Students will be able to identify various life forms of plants, design and execute experiments related to basic studies on evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology.
4. Students are also familiarized with the use of bioinformatics tools and databases and in the application of statistics to biological data.
5. Students will acquire core competency in the subject Botany and in allied subject areas. They will be able to use the evidence based comparative studies approach to explain the evolution of organism and understand the genetic diversity and its significance.

6. The students will be able to explain various physiological and metabolic processes unique to plants. They would be able to elaborate on the concepts of gene, genome and the molecular processes of replication, transcription and translation. They will be able to understand adaptation, development and behavior of different forms of life. The students will get an understanding of functioning of ecosystem and tracing the energy pyramids through nutrient flow.
7. Students will be able to demonstrate the experimental techniques and methods in plant sciences and have innovative research ideas.

### **Semester -1**

#### **Core course I: Microbiology and Phycology (BHCC1) Credit:6**

Students would have understanding of the classification, characteristic features, cell structure and growth and reproduction in viruses, bacteria, and various groups of marine and fresh water algae and their ecological and economic importance.

#### **Core course II: Biomolecules and Cell Biology (BHCC2) Credit:6**

This course will be able to demonstrate foundational knowledge in understanding of:

1. The relationship between the properties of macromolecules, their cellular activities and biological responses.
2. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle.
3. Contemporary approaches in modern cell and molecular biology.

#### **Generic Elective I: Biodiversity (Microbes, Fungi, Algae, and Archegoniatae)**

1. Combination of Theoretical and Practical components will provide comprehensive information and insight into the fascinating world of Microbes and Plants.
2. Hands on Training will help students learn use of microscope, mounting, section-cutting and staining techniques for the study of plant materials.
3. Making Drawings in Practical Records will enhance understanding morphological and structural details and related functional aspects in diverse plant groups.
4. Use of Illustrations, Photographs, Charts, Permanent Slides, Museum and Herbarium Specimens along with ICT Methods will provide an interesting insight into the beautiful world of microbes and plants.
5. Scope of Biodiversity includes Medicinal field, Industry, Agriculture, Research and Study, Job Opportunities and Environmental Conservation. This paper is both informative and interesting and will enable students to learn about Biodiversity not only as a plant or nature lover, but also for higher academic pursuits, particularly in the field of Biological Sciences, Environment and Biodiversity Conservation.

### **Semester 2**

#### **Core course III: Mycology and Phytopathology (BHCC3) Credit:6**

Upon completion of this course, the students will be able to:

1. Understand the world of fungi, lichens and pathogens of plants.
2. Appreciate the characteristics of the fungi and lichens.
3. Understand the ecological and economic significance of lichen.
4. Understand the application of mycology in various fields of economic and ecological significance.
5. Understand the economic and pathological importance of fungi, bacteria and viruses
6. Identify common plant diseases and their control measures

#### **Core course IV: Archegoniatae (BHCC4) Credit:6**

The students will be made aware of the group of plants that have given rise to land habit and the flowering plants. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity. to my knowledge students should create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants.

#### **Generic Elective II: Plant Ecology and Taxonomy**

After successful completion of the course the student shall have adequate knowledge about the basic principles of environment and taxonomy

### **Semester 3**

#### **Core course V: Anatomy of Angiosperms (BHCC5) Credit:6**

1. Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants.
2. Various aspects of growth, development of the tissues and differentiation of various plant organs. Knowledge of basic structure and organization of plant parts in angiosperms.
3. Correlation of structure with morphology and functions.

#### **Core course VI: Economic Botany (BHCC6) Credit:6**

After studying Economic Botany, students would have first hand information of plants used as food, the various kinds of nutrients available in the plants. The dietary requirements of proteins, fats, amino-acids, vitamins etc. that can be met by plants. The students will learn to perform the micro-chemical tests to demonstrate various components. The students will learn about the use of fibre plants, beverages, fruits and vegetables that are integral to day to day life of plants. Students will learn to explore the regional diversity in food crops and other plants and their ethno-botanical importance as well.

#### **Core course VII: Genetics (BHCC7) Credit:6**

To generate interest among the students in Genetics and make them aware about the importance and opportunities in higher education and research, the first unit should be Introductory dealing with how this area has revolutionized all aspects of our life from its growth from Mendel to

Genetic Engineering. Modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation are the basic learning.

**Skill Enhancement course I: Ethnobotany (BHSE1) Credit:4**

Students would have an understanding of the treasure, value and usefulness of the natural products and their efficient use by the local communities as food and medicine and their conservation practices

**Skill Enhancement course I: Intellectual Property Rights (BHSE2) Credit:4**

Students would have deep understanding of patents copyrights, their importance. They can think about the importance of traditional knowledge, bio-prospecting, biopiracy. They would gain the knowledge of farmers rights and the importance on indigenous plant varieties, concept of novelty and biotechnological inventions.

**Generic Elective III: Plant Physiology and Metabolism (BHGE5) Credit:6**

The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning. The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.

**Semester 4**

**Core course VIII: Molecular Biology (BHCC8) Credit:6**

1. Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
2. Processing and modification of RNA and translation process, function and regulation of expression.
3. Application in biotechnology

**Core course IX: Ecology (BHCC9) Credit:6**

It will acquaint the students with complex interrelationship between organisms and environment; make them understand methods to studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

**Core course X: Plant Systematics (BHCC10) Credit:6**

Understanding of systematics its importance in bioresource utilization and biodiversity management. Nomenclature pattern, Phylogeny, Classification systems of the plants.

**Skill Enhancement course II: Biofertilizers (BHSE3) Credit:4**

The student would have a deep understanding of ecofriendly fertilizers. They will be able to understand the growth and multiplication conditions of useful microbes such as *Rhizobium*, cyanobacteria, mycorrhizae, *Azotobactor* etc, their role in mineral cycling and nutrition to plants.

They can also think of the methods of decomposition of biodegradable waste and convert into the compost

#### **Generic Elective IV: Economic Botany and Biotechnology (BHGE7) Credit:6**

Understanding of morphology, and processing and economic value of plant sources of cereals, legumes, spices, oil rubber, timber and medicines.

### **Semester 5**

#### **Core course XI: Reproductive Biology of Angiosperms (BHCC11) Credit:6**

Student would have an understanding of

1. Induction of flowering and molecular and genetic aspects of flower development.
2. Pollen development, dispersal and pollination
3. Ovule development and fertilization,
4. Endosperm development and its importance
5. alternation pathways of reproduction
6. Student would be able to apply this knowledge for conservation of pollinators and fruit development

#### **Core course XII: Plant Physiology (BHCC12) Credit:6**

The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning. The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.

#### **Discipline Specific Elective-I: Analytical Techniques in Plant Sciences (BHDS1) Credit:6**

Understanding of principles and use of light, confocal transmission and electron microscopy, centrifugation, spectrophotometry, chromatography, x-ray diffraction technique and chromatography techniques

#### **Discipline Specific Elective-II: Biostatistics (BHDS2) Credit:6**

Understanding of interpreting the scientific data that is generated during scientific experiments. It is the responsibility of biostatisticians and other experts to consider the variables in subjects to understand them, and to make sense of different sources of variation. In essence, the goal of biostatistics is to disentangle the data received and make valid inferences that can be used to solve problems in public health. Biostatistics uses the application of statistical methods to conduct research in the areas of biology, public health, and medicine. Many times, experts in biostatistics collaborate with other scientists and researchers.

### **Semester 6**

#### **Core course XIII: Plant Metabolism (BHCC13) Credit:6**

- Concept and significance of metabolic redundancy in plants.

- Students will also be able to learn the similarity and differences in metabolic pathways in animals and plants.
- To have understanding of water and nutrient uptake and movement in plants, role of mineral elements, translocation of sugars, Role of various plant growth regulators, phytochrome cytochromes and phototropins, and flowering stimulus.

#### **Core course XIV: Plant Biotechnology (BHCC14) Credit:6**

The successful students will be able to:

- Learn the basic concepts, principles and processes in plant biotechnology.
- Have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural applications.
- Use basic biotechnological techniques to explore molecular biology of plants
- Explain how biotechnology is used to for plant improvement and discuss the biosafety concern and ethical issue of that use.

#### **Discipline Specific Elective-IV: Industrial and Environmental Microbiology (BHDS3) Credit:6**

Upon successful completion of the course, students are expected to be able to:

1. Understand how microbiology is applied in manufacturing of industrial products
2. Know about design of bioreactors, factors affecting growth and production
3. Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air
4. Comprehend the different types of fermentation processes
5. Comprehend the techniques and the underlying principles in upstream and down- stream processing
6. Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection
7. Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
8. Understand the basic principles of environment microbiology and application of the same in solving environmental problems – waste water treatment and bioremediation
9. Comprehend the various methods to determine the quality of water

#### **Discipline Specific Elective-IV: Bioinformatics (BHDS4) Credit:6**

With a working knowledge of the practical and theoretical concepts of bioinformatics, you will be well qualified to progress onto advanced graduate study. The portfolio of skills developed on the programme is also suited to academic research or work within the bioinformatics industry as well as range of commercial settings.

### **B.Sc. Programme in Life Sciences (LOCF)**

#### **(Botany Component)**

## **LEARNING OUTCOME BASED CURRICULUM FRAMEWORK**

Combination of Theoretical and Practical components will provide comprehensive information and insight into the

1. Fascinating world of Microbes and Plants.
2. Hands on Training will help students learn use of microscope, mounting, section-cutting and staining techniques for the study of plant materials.
3. Making Drawings in Practical Records will enhance understanding morphological and structural details and related functional aspects in diverse plant groups.
4. Use of Illustrations, Photographs, Charts, Permanent Slides, Museum and Herbarium Specimens along with ICT Methods will provide an interesting insight into the beautiful world of microbes and plants.
5. Scope of Biodiversity includes Medicinal field, Industry, Agriculture, Research and Study, Job Opportunities and Environmental Conservation. This paper is both informative and interesting and will enable students to learn about Biodiversity not only as a plant or nature lover, but also for higher academic pursuits, particularly in the field of Biological Sciences, Environment and Biodiversity Conservation.
6. The relationship between the properties of macromolecules, their cellular activities and biological responses.
7. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelles.
8. Contemporary approaches in modern cell and molecular biology.
9. Understand how plant sciences and microbiology is applied in manufacturing of industrial products
10. Know about design of bioreactors, factors affecting growth and production
11. Comprehend the techniques and the underlying principles in upstream and down- stream processing
12. Learn the occurrence, abundance and distribution of microorganism in the environment and their role in the environment and also learn different methods for their detection
13. Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
14. Understand the basic principles of organism and environment interaction and application of the same in solving environmental problems – waste water treatment and bioremediation
15. Learn the basic concepts, principles and processes in plant biotechnology.
16. Have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural applications.
17. Use basic biotechnological techniques to explore molecular biology of plants Explain how biotechnology is used to for plant improvement and discuss the biosafety concern and ethical issue of that use.

## **COURSE LEARNING OUTCOME**

The course learning outcomes are aligned with program learning outcomes but these are specific-to-specific courses offered in a program. The course level learning shall be reflected as program level learning. The core courses shall be the backbone of this framework whereas discipline electives, generic electives and skill enhancement courses would add academic excellence in the subject together with multi-dimensional and multidisciplinary approach.

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2. Understanding of various life forms of plants, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, transgenic technology and use of bioinformatics tools and databases and the application of statistics to biological data.

### **Semester 1**

#### **LSCC2 Core Course - (CC) Credit: 6- Biodiversity (Microbes, Fungi, Algae and Archegoniatae)**

The students will be made aware of the various groups of organisms, Bacteria, viruses, algae bryophytes, pteridophytes and gymnosperms that have given rise to land habit. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity. to my knowledge students should create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as videos in case they are able to find some rare structure or phenomenon related to these plants. Students would have understanding of the classification, characteristics features, cell structure and growth and reproduction in viruses, bacteria, and various groups of marine and fresh water algae and their ecological and economic importance.

Upon completion of this course, the students will be able to:

1. Understand the world of fungi, and pathogens of plants
2. Appreciate the characteristics of the fungi
3. Understand the ecological and economic significance of lichen
4. Understand the application of mycology in various fields of economic and ecological significance
5. Understand the economic and pathological importance of fungi, bacteria and viruses
6. Identify common plant diseases and their control measures

### **Semester 2**

#### **LSCC3 Core Course - (CC) Credit:6- Plant Ecology and Taxonomy**

After successful completion of the course the student shall have adequate knowledge about the basic principals of environment and taxonomy.

### **Semester 3**

#### **LSCL4 Core Course - (CC) Credit:6- Plant Anatomy and Embryology**

Knowledge regarding anatomy equipped the students to identify different types of tissues and make them able to correlate their physiology in a better away. This will also help them to understand how different plant tissue evolve and modify their structure and functions with respect



to their environment. Knowledge regarding embryology make them understand how reproduction play significant role in defining population structure, natural diversity and sustainability of ecosystem in a better way.

### **LSSE1 Skill-Enhancement Elective Course - (SEC) Credit:4- Biofertilizers**

The student would have a deep understanding of ecofriendly fertilizers. They will be able to understand the growth and multiplication conditions of useful microbes such as Rhizobium, cyanobacteria, mycorrhizae, *Azotobactor* etc, their role in mineral cycling and nutrition to plants. They can also think of the methods of decomposition of biodegradable waste and convert into the compost.

## **Semester 4**

### **LSCC1 Core Course - (CC) Credit:6- Plant Physiology and Metabolism**

The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning. The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.

### **LSSE2 Skill-Enhancement Elective Course - (SEC) Credit:4- Medicinal Botany**

#### Knowledge Skills

- An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine.
- To develop an understanding of the constraints in promotion and marketing of medicinal plants. Professional and Practical Skills.
- Transforming the knowledge into skills for promotion of traditional medicines.
- Developing entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

## **Semester 5**

### **LSDS2 Discipline Specific Elective - (DSE) Credit:6- Cell and Molecular Biology**

This course will be able to demonstrate foundational knowledge in understanding of: The relationship between the properties of macromolecules, their cellular activities and biological responses Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle Contemporary approaches in modern cell and molecular biology. Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process. Processing and modification of RNA and translation process, function and regulation of expression. Application in biotechnology.

### **LSSE3 Skill-Enhancement Elective Course - (SEC) Credit:4- Ethnobotany**

Students would have an understanding of the treasure, value and usefulness of the natural products and their efficient use by the local communities as food and medicine and their conservation practices.

### **Semester 6**

#### **LSDS3 Discipline Specific Elective - (DSE) Credit:6- Analytical Techniques in Plant Sciences**

Understanding of principles and use various methods, tools and techniques used in plant sciences such as light microscopy, confocal transmission and electron microscopy, centrifugation, spectrophotometry, chromatography, x-ray diffraction technique and chromatography techniques.

#### **LSSE6 Skill-Enhancement Elective Course - (SEC) Credit:4- Intellectual Property Rights**

Students would have deep understanding of patents copyrights, their importance. They can think about the importance of traditional knowledge, bio-prospecting, biopiracy. They would gain the knowledge of farmers rights and the importance on indigenous plant varieties, concept of novelty and biotechnological inventions.