BSc. (Hons.) Botany

Learning Outcomes

DISCIPLINE SPECIFIC CORE COURSE

SEMESTER -I

DSC-1: PLANT DIVERSITY AND EVOLUTION

Learning Objectives

The Learning Objectives of this course are as follows:

- To make students aware about the diversity of plants and microbes present on the planet and how are they possibly related to each other in light of evolution.

Learning outcomes

The Learning Outcomes of this course are as follows:

By studying this course students will gain basic knowledge on

- The diversity of plants and microbes
- Their general characteristics
- Various groups of plants and their evolutionary relationships
- Basic principles and concepts of evolution that contribute to plant diversity

DSC-2: CELL BIOLOGY: ORGANELLES AND BIOMOLECULES

Learning Objectives

The Learning Objectives of this course are as follows:

- Cell as a structural and functional unit of life.
- Types of biomolecules (proteins, carbohydrates, lipids and nucleic acids) and their rolesin cell structure and function.

- Structures of different organelles and their role in fundamental metabolic processes of a cell.

Learning outcomes

The Learning Outcomes of this course are as follows:

By studying this course students will gain basic knowledge on

- The relationships between the properties of macromolecules, their cellular activities and biological functions.
- Physico-chemical composition of organelles and their functional organization.
- Basic principles and concepts of evolution that contribute to plant diversity.

DSC-3: BASIC LABORATORY AND FIELD SKILLS IN PLANT BIOLOGY

Learning Objectives

The course will help students gain knowledge about:

- To learn fundamental skills important for performing laboratory and field experiments

Learning outcomes

This course will be able to demonstrate basic knowledge and understanding of:

- Good laboratory practices, management of laboratory waste, understanding hazardsand risks to ensure a safe laboratory environment.
- Basics of measurements, units and common mathematical calculations, sampling and data collection.
- Operation and maintenance of instruments
- Presentation, analysis of data and interpretation of results.

SEMESTER-II

DSE 4: MICROBIOLOGY AND PLANT-MICROBE INTERACTIONS

Learning Objectives

The Learning Objectives of this course are as follows:

To impart basic understanding about microbial world and their interactions with plants.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understanding microbes and their roles and applications.
- Understanding about modes of reproduction of Viruses, Archaebacteria, Eubacteria.
- Understand plant-microbe interaction

DSE 5: PLANT RESOURCES AND ECONOMIC BOTANY

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize students with the economic importance of diverse plant species and train them in identifying plants of economic importance through field visit/s, live plant specimens, herbarium specimens and digital resources.
- To make students understand the importance of various plant parts and derived products used as food, fibers, medicines, oils and other economically important products.
- To acquaint students with the processing of various economically important plant resources and train them to identify and analyses nutrients using simple microchemical tests.

Learning outcomes

The Learning Outcomes of this course are as follows:

● This course would provide students with information about the economic importance and products derived from plants and their roles in our daily lives.

● Students will learn to perform micro-chemical tests to study presence of various components.

● Students will explore the regional diversity in food crops and other plants and their ethnobotanical importance

DSE 6: PLANT SYSTEMATICS

Learning Objectives

The course will help students gain knowledge about:

- The basics of plant systematics and its inter-relationships with allied subject areas

Learning outcomes

On completion of the course the students will be able to:

- Understand technical terminology used in plant taxonomy
- Apply the terminologies to describe, identify and classify flowering plants
- Search and analyse taxonomic information from internet-based scientific databases and other resources
- Interpret and evaluate the concept of species and evolutionary processes in angiosperms
- Comprehend and compare various systems of classifications
- Recognise diversity in local/regional flora
- Appreciate the significance and application of systematics in science and welfare of society

SEMESTER-III

DSE 7: PHYCOLOGY THE WORLD OF ALGAE

Learning Objective:

To provide students with in depth knowledge of the unique group of algae that are the primary photosynthetic organisms.

Learning Outcomes:

By studying this course students will gain basic knowledge on algae, with reference to:

- The diversity and general characteristics.
- Distinguishing features of taxa belonging to different families.
- The various ecological and economic benefits.

DSE 8: BRYOPHYTES, PTERIDOPHYTES AND GYMNOSPERMS

Learning Objectives

- Provide a deep understanding of morphology, anatomy, reproduction and developmental biology of these unique groups of non-flowering plants.
- Enhance understanding of diversity, economic value, taxonomy in representative members of phylogenetically important groups.

Learning Outcomes:

At the end of this course students will be able to:

- Identify and describe the group of plants that have given rise to land habit and the flowering plants.
- Comprehend various phenological stages of the plants belonging to the sub groups bryophytes, pteridophytes and gymnosperms.

DSE 9: GENETICS & PLANT BREEDING

Learning Objectives:

- To apprise students with the basic principles of Genetics
- To enhance the applications of genetics in plant breeding and agriculture.

Learning Outcomes:

On completion of the course the students will be able to:

- Understand the fundamentals of Mendelian inheritance and its deviation in gene
- interactions.
- Describe the concepts of linkage and crossing over and their usage in constructing gene maps.
- Become familiar with pedigree analysis.
- Learn about principles of population genetics
- Gain knowledge about gene mutations and inherited disorders
- Learn about various plant breeding techniques / methods

GE: FUNDAMENTALS OF MOLECULAR BIOLOGY

Learning Objectives:

- To gain the knowledge of structure and functions of DNA and RNA

Learning Outcomes:

Students would have understanding of

- 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.

SEMESTER-IV

DSE 10: MYCOLOGY

Learning Objectives:

- To introduce students with various fungal groups and lichens, their ecology, classification, characteristics, reproduction and economic Importance
- To introduce students to the role of fungi in biotechnology, food industry, agriculture, human health and diseases etc.

Learning Outcomes

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

- Understand the world of fungi, lichens and pathogens of plants
- Understand characteristics the ecological and economic significance of the fungi and lichens
- Understand the application of mycology in various fields of economic and ecological significance

DSE 11: ECOLOGY AND CONSERVATION

Learning Objectives

- To introduce the students with environmental factors affecting the plants, the basic principles of ecology and phytogeography.
- To make them understand community patterns and processes, and ecosystem functioning.

Learning Outcomes

At the end of this course, students will be able to understand:

- The interrelationship between organisms and environment.
- Methods to study vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
- Evolving strategies for sustainable natural resource management and biodiversity conservation.

DSE 12: DEVELOPMENTAL BIOLOGY OF ANGIOSPERMS: FORM, ANATOMY & FUNCTION

Learning Objectives:

● To understand the basics of plant cell structure, and development, growth and organisation of the plant body.

Learning Outcomes:

Upon completion of the course, the students will

- Become familiar with the structure and functions of various components of plant cell
- Understand the process of cell growth and its regulation
- Comprehend the structure and functions of tissues organising the various plant organs
- Get acquainted with the reproductive processes involved in the life cycle of angiosperms
- Be able to appreciate the interactions between the developmental pathways resulting in the differentiation of plant body
- Recognise the importance of plant developmental biology in the improvement and conservation of plants.

SEMESTER-V

LSDS2 Discipline Specific Elective - (DSE)

Cell and Molecular Biology

Learning Outcomes

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)- Ethnobotany

Learning Outcomes

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-IV

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

Learning Outcomes

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)- Intellectual Property Rights

Learning Outcomes

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.

Core course V: Anatomy of Angiosperms (BHCC5)

- Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants.
- 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.
- Correlation of structure with morphology and functions.

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

Learning Outcomes

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)

Learning Outcomes

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 corelation are the basic learning.

Skill Enhancement course I: Ethnobotany (BHSE1)

Learning Outcomes

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)

Learning Outcomes

Students would have deep understanding of patents copyrights, their importance. Thy 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)

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-IV

Core course VIII: Molecular Biology (BHCC8)

- 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

Core course IX: Ecology (BHCC9)

Learning Outcomes

This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Core course X: Plant Systematics (BHCC10)

Learning Outcomes

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)

Learning Outcomes

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)

Learning Outcomes

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

SEMESTER-V

Core course XI: Reproductive Biology of Angiosperms (BHCC11)

Learning Outcomes

Student would have an understanding of

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

Core course XII: Plant Physiology (BHCC12)

Learning Outcomes

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)

Learning Outcomes

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)

Learning Outcomes

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-VI

Core course XIII: Plant Metabolism (BHCC13)

Learning Outcomes

- 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

Learning Outcomes

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)

Learning Outcomes

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

- Understand how microbiology is applied in manufacturing of industrial products
- Know about design of bioreactors, factors affecting growth and production
- Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air
- Comprehend the different types of fermentation processes
- Comprehend the techniques and the underlying principles in upstream and down- stream processing

- 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
- Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
- Understand the basic principles of environment microbiology and application of the same in solving environmental problems – waste water treatment and bioremediation
- Comprehend the various methods to determine the quality of water

Discipline Specific Elective-IV: Bioinformatics (BHDS4)

Learning Outcomes

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

Learning Outcomes

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

- Fascinating world of Microbes and Plants.
- Hands on Training will help students learn use of microscope, mounting, section-cutting and staining techniques for the study of plant materials.
- Making Drawings in Practical Records will enhance understanding morphological and structural details and related functional aspects in diverse plant groups.
- 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.

- 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.
- The relationship between the properties of macromolecules, their cellular activities and
- biological responses.
- Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelles.
- Contemporary approaches in modern cell and molecular biology.
- Understand how plant sciences and microbiology is applied in manufacturing of industrial products
- Know about design of bioreactors, factors affecting growth and production
- Comprehend the techniques and the underlying principles in upstream and down- stream processing
- 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
- Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
- Understand the basic principles of organism and environment interaction and application of the same in solving environmental problems – waste water treatment and bioremediation
- 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.

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. 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.

SEMESTER -V

Core course XI: Reproductive Biology of Angiosperms (BHCC11)

Student would have an understanding of

- Induction of flowering and molecular and genetic aspects of flower development.
- Pollen development, dispersal and pollination
- Ovule development and fertilization,
- Endosperm development and its importance
- alternation pathways of reproduction

- Student would be able to apply this knowledge for conservation of pollinators and fruit
- development.

Core course XII: Plant Physiology (BHCC12)

The students are able to correlate morphology, anatomy, cell structure and bio-chemistry 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)

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)

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 -VI

Core course XIII: Plant Metabolism (BHCC13)

Learning Outcomes

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)

Learning Outcomes

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)

Learning Outcomes

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

- Understand how microbiology is applied in manufacturing of industrial products
- Know about design of bioreactors, factors affecting growth and production
- Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air
- Comprehend the different types of fermentation processes

- Comprehend the techniques and the underlying principles in upstream and down-stream processing
- 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
- Understand various biogeochemical cycles – Carbon and Nitrogen, and microbes involved
- Understand the basic principles of environment microbiology and application of the same in solving environmental problems – waste water treatment and bioremediation
- Comprehend the various methods to determine the quality of water

Discipline Specific Elective-IV: Bioinformatics (BHDS4)

Learning Outcomes

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.