

Department of Botany
Bhairab Ganguly College

Student Learning Outcomes

Course Outcomes – B.Sc. Botany (CBCS Degree (UG) Programme)

Systematic, extensive and coherent knowledge and understanding of plant science as a whole and its applications and links to disciplinary areas of the study; including critical understanding of the established theories, principles and concepts of a number of advanced and emerging issues in the field of Botany.

Procedural knowledge that creates different types of professionals in the field of Botany like in research and development, teaching government and public services e.g. conservationist, plant explorer, ecologist, horticulturist, plant biochemist, genetics, nursery manager, molecular biologist, plant pathologist, taxonomist, farming consultant and environmental consultant.

Developing skills and ability to use knowledge efficiently in areas related to specializations and current updates in Botany.

Knowledge about plants, current research, scholarly and professional literature of advanced learning areas of Botany.

Application of knowledge for understanding and developing skills for critical assessment of wide range of ideas and problems in the field of Botany.

Communication of the results of studies in the academic field of Botany using main concepts, constructs and techniques.

Application of knowledge and understanding of Botany to new/unfamiliar contexts and to identify problems and solutions in daily life

Course Specific Outcomes – B.Sc. Botany (HONOURS)

- **Semester-I**
 - **C1 - Phycology and Microbiology (BOTACOR01T, BOTACOR01P)**
 - On completion of the course, students are able to:
 - Understand the diversity among Bacteria, Viruses and Algae.
 - Know the systematic, morphology and structure, of Bacteria, Viruses and Algae.

- Understand the life cycle pattern of Bacteria, Viruses and Algae.
 - Understand the useful and harmful activities of Bacteria, Viruses and Algae .
 - **C2 - Biomolecules and Cell Biology (BOTACOR02T, BOTACOR02P)**
 - On completion of the course, students are able to:
 - Know about structure and properties of Macromolecules.
 - Thermodynamics, Enzyme catalysis and activation energy – Mechanism of enzyme action
 - Know the structure of Cell components and their functions.
 - Know the regulation and characteristics, phases of cell division in plants.
- **Semester-II**
 - **C3 - Mycology and Phytopathology (BOTACOR03T, BOTACOR03P)**
 - On completion of the course, students are able to:
 - Understand the Biodiversity of Fungi
 - Know the Economic Importance of Fungi
 - Understand the features of Lichens
 - Know the terminologies in plant pathology
 - Understand the scope and importance of Plant Pathology
 - Know the control measures of plant diseases
 - **C4 – Archegoniate (BOTACOR04T, BOTACOR04P)**
 - On completion of the course, students are able to:
 - Understand the morphological diversity of Bryophytes, Pteridophytes and
 - Understand the economic importance of the Bryophytes, Pteridophytes and Gymnosperms.
 - Know the evolution of Bryophytes, Pteridophytes and Gymnosperms in particular and land plants in general.
- **Semester-III**
 - **C5 - Morphology and Anatomy (BOTACOR05T, BOTACOR05P)**
 - On completion of the course, students are able to:
 - Understand the habit of the angiosperm plant body.
 - Know the vegetative characteristics of the plant.
 - Understand the plant morphology and anatomy.
 - Know various tissue systems.
 - **C6 - Economic Botany (BOTACOR06T, BOTACOR06P)**
 - On completion of the course, students are able to:
 - Understand the role plants in human welfare.
 - Gain knowledge about various plants of economic use
 - Know importance of plants & plant products
 - Understand the chemical contents of the plant products
 - Know about the utility of plant resources

- **C7 - Genetics (BOTACOR07T, BOTACOR07P)**
 - On completion of the course, students are able to:
 - Understand properties of hereditary molecule and study experiments proving chromosomes to be seat of heredity
 - Learn about Mendelian principles, pedigree analysis and heredity traits and disorders.
 - Know about crossing-over, linkage, gene mapping methods, Extra chromosomal inheritance and sex-linked inheritance.

- **SEC1 - Plant Diversity and Human Welfare (BOTSSEC01M)**
 - On completion of the course, students are able to:
 - Understand the morphological diversity among Bacteria, Viruses, Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
 - Observe vegetative and reproductive parts of various life forms of Bacteria, Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
 - Become aware of the status of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms. as a group in plant kingdom.
 - Understand the life cycles of selected genera.
 - Learn about the economic and ecological importance these plant groups.

- **Semester-IV**
 - **C8 - Molecular Biology (BOTACOR08T, BOTACOR08P)**
 - On completion of the course, students are able to:
 - Understand the function of cells at molecular level.
 - Plant Molecular Biology focuses on exploration of molecular basis of plant life.
 - Learn about synthesis and processing of DNA, RNA, Protein, molecular systems and regulation of gene expression in prokaryotic and eukaryotic organisms.

 - **C9 - Plant Ecology and Phytogeography (BOTACOR09T, BOTACOR09P)**
 - On completion of the course, students are able to:
 - Know the scope and importance of the discipline.
 - Understand plant communities and ecological adaptations in plants
 - Learn about conservation of biodiversity, Non-conventional Energy and Pollution.
 - Discover botanical regions of India and vegetation types of Maharashtra.
 - Understand Bioremediation, Global warming and climate change.

 - **C10 - Plant Systematics (BOTACOR10T, BOTACOR10P)**
 - On completion of the course, students are able to:
 - Understand the diversity of angiosperms and know the Pre-Darwinian and Post- Darwinian systems of Classification.

- Understand the comparative account among the families of angiosperms.
 - Understand the distinguishing features of angiosperm families.
 - Understand rules and applications of ICN.
 - Realize the origin of Angiosperms with respect to time, place, origin and probable ancestors.
 - Identify plant and associate it with proper nomenclature.
 - **SEC2 – Ethnobotany (BOTSSEC02M)**
 - On completion of the course, students are able to:
 - Know about history and relevance of herbal drugs in Indian system of medicine
 - Learn the macroscopic and microscopic characters, chemical constituents, adulterants, therapeutical and pharmaceutical uses of medicinal plants
 - Understand the techniques for drug evaluation (Chemical, Physical and Biological), Phytochemical investigations, standardization and quality control of herbal drugs
 - Know the technique of medicinal gardening - Cultivation practices, marketing and utilization of selected medicinal plants
- **Semester-V**
 - **C 11- Reproductive Biology of Angiosperms (BOTACOR11T,BOTACOR11P)**
 - On completion of the course, students are able to:
 - Understand the scope & importance of Embryology
 - Understand the normal and anomalous secondary growth in plants and their causes.
 - Perform the techniques in anatomy
 - Understand structure and development in microsporangium and megasporangium
 - Understand microsporogenesis and megasporogenesis
 - Understand male and female gametophytes
 - Know fertilization, endosperm and embryogeny
 - **C12 - Plant Physiology (BOTACOR12T, BOTACOR12P)**
 - On completion of the course, students are able to:
 - Know importance and scope of plant physiology.
 - Understand the plants and plant cells in relation to water.
 - Learn about the movement of sap and absorption of water in plant body.
 - Understand the plant, growth, flowering, movement, light response, dormancy and germination.
 - **DSE1 - Natural Resource Management (BOTADSE01T, BOTADSE01P)**
 - On completion of the course, students are able to:

- Define natural resources, Sustainable utilization and understand economic, ecological and socio-cultural approaches towards sustainable utilization.
 - Learn about utilization, degradation, and management of energy, land, water and Biological Resources i.e. Bioprospecting, Forest products; IPR; CBD; National Biodiversity Action Plan.
 - Learn about contemporary practices in resource management; EIA, GIS, Participatory Resource Appraisal, Ecological Footprint with emphasis on carbon footprint, Resource Accounting; Waste management. National and international efforts in resource management and conservation IUCN, UNESCO, UNEP, IBIN, WBBDB, BSI, ZSI
 - Learn to collect data on vegetation covers of specific areas, measure dominance of woody species by DBH (diameter at breast height) method, calculate and analyze ecological footprint.
- **DSE2 - Horticultural Practices and Post-Harvest Technology (BOTADSE02T, BOTADSE02P)**
- On completion of the course, students are able to:
 - Learn about scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism.
 - Able to identify ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (Opuntia, Agave and Spurges)] and flowering trees (Indian laburnum, gulmohar, Jacaranda, Lagerstroemia, fishtail and areca palms, semul, Coral tree); fruit and vegetable crop varieties of citrus, banana, mango, chillies and cucurbits.
 - Learn production, origin and distribution; management and marketing of vegetable and fruit crops; application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods; Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Disease control and management nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops.
 - Learn planning and layout of parks and avenues; gardening traditions; Floriculture: Cut flowers, bonsai, commerce (market demand and supply); and Post-harvest technology: evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing losses during storage

and transportation; Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures.

○ **DSE3 - Industrial and Environmental Microbiology (BOTADSE03T, BOTADSE03P)**

- On completion of the course, students are able to:
- Understand scope of microbes in industry and environment, types of Bioreactors/Fermenters and fermentation. Techniques for industrial production of microbial products i.e. amylase or lipase activity, Organic acid (citric acid or glutamic acid), alcohol (Ethanol) and antibiotic (Penicillin), microorganism screening for microbial enzymes i.e. casein hydrolysis; starch hydrolysis; cellulose hydrolysis.
- Learn about Distribution of microbes in air; Water pollution, role of microbes in sewage and domestic waste water treatment systems. Microorganisms as indicators of Biological fixation; Mycorrhizae; Bioremediation of contaminated soils.
- Able to isolate microorganisms from soil, air and water. Determine of BOD, COD, TDS and TOC of water samples, Isolate root nodulating bacteria, arbuscular mycorrhizal colonizing plant roots. Assess water quality, check coliform and faecal coliform in water samples.

● **Semester-VI**

○ **C14 - Plant Metabolism (BOTACOR13T, BOTACOR13P)**

- Understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C3 and C4 pathways.
- Understand the respiration in higher plants with particular emphasis on aerobic and anaerobic respiration.
- Understand plant nutrition, ATP synthesis, Nitrogen and Lipid metabolism.

○ **C15 - Plant Biotechnology (BOTACOR14T, BOTACOR14P)**

- Understand the basic principles of plant tissue culture
- Acquire knowledge on sources of biomass and bio-energy.
- Know about the genetic transformation methods and metabolic engineering

○ **DSE4 - Analytical Techniques in Plant Sciences (BOTADSE04T, BOTADSE04P)**

- On completion of the course, students are able to:
- Learn about principles of different types of microscopy; types of centrifugation, spectrophotometry, chromatography; techniques of characterization of proteins and nucleic acids; use of radioisotopes in biological research; preliminary biostatistics.

- Able to use electrophoresis and Blotting techniques for DNA, RNA, and , protein characterization, paper chromatography for nitrogenous bases separation by, layer chromatography for sugar separation, prepare slides for microscopic studies.
- **DSE5 – Bioinformatics (BOTADSE05T, BOTADSE05P)**
 - On completion of the course, students are able to:
 - Learn about scope, branches and Research areas of Bioinformatics, Aim, Scope and of Bioinformatics; Biological Databases, information submission to and retrieval from databases.
 - Able to handle and analyze nucleic acid and protein sequences, perform multiple sequence alignments, and Phylogenetic Analyses using different computational tools.
 - Learn about applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.
- **DSE6 – Biostatistics (BOTADSE06T, BOTADSE06P)**
 - On completion of the course, students are able to:
 - Learn basic principles of statistical methods, measurements, functions, limitations and uses of statistics; types and methods of data collection procedures - merits and demerits. Classification - tabulation and presentation of data.
 - Able to calculate mean, median, mode, geometric mean; dispersion - range, standard deviation, mean deviation, quartile deviation; Co- efficient of variations; correlation, regression coefficients, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression; student 't' test and chi square test.

Course Specific Outcomes – B.Sc. with Botany

• Semester I

- **DSC1/GE1 - Biodiversity (Microbes, Algae, Fungi and Archegoniate) (BOTHGEC01T, BOTHGEC01P)**
 - On completion of the course, students are able to:
 - Understand the morphological diversity among Bacteria, Viruses, Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
 - Observe vegetative and reproductive parts of various life forms of Bacteria, Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
 - Become aware of the status of Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms. as a group in plant kingdom.
 - Understand the life cycles of selected genera.

- Learn about the economic and ecological importance these plant groups.
- **Semester II**
 - **DSC2/GE2 - Plant Ecology and Taxonomy (BOTHGEC02T, BOTHGEC02P)**
 - On completion of the course, students are able to:
 - Understand the biotic and abiotic ecological factors, Shelford law of tolerance, ecological adaptation of plants, plant communities characters; Succession; Ecotone and edge effect; principle biogeographical zones; Endemism
 - Learn basic ecology principles i.e. energy flow, trophic organisation; Food chains and food webs, Ecological pyramids; production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen.
 - Learn about principles of plant traditional and numerical taxonomy, Identification, Classification, Nomenclature, herbariums, botanical gardens, taxonomic documentation, evidences; ranks and categories; selected classifications; Principles and Rules of ICN
 - Understand the diversity of angiosperms with reference to selected families.
- **Semester III**
 - **DSC3/GE3 - Plant Anatomy and Embryology (BOTHGEC03T, BOTHGEC03P)**
 - On completion of the course, students are able to:
 - Understand the habit of the angiosperm plant body, the vegetative characteristics of the plant, various tissue systems; the normal and anomalous secondary growth in plants and their causes.
 - Understand the scope & importance of Embryology; structure and development in microsporangium and megasporangium; microsporogenesis and megasporogenesis, types fertilization, embryosac development, endosperm and embryogeny
 - Able to identify various tissue systems; types of primary and secondary growth, types of ovules and stages of embryo development.
 - **SEC1 - Plant Diversity and Human Welfare (BOTSSEC01M)**
 - On completion of the course, students are able to:
 - Learn about plant diversity and its scope, threats to plant biodiversity and management, organizations associated with biodiversity management - IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.
 - Understand principles, function and strategies of conservation of Biodiversity and sustainable development.

- Learn role of plants in relation to Human Welfare and commercial importance: forestry and forest products, avenue trees, ornamental plants, alcoholic beverages, Fruits and nuts.
- **Semester IV**
 - **DSC4/GE4 - Plant Physiology and Metabolism (BOTHGEC04T, BOTHGEC04P)**
 - On completion of the course, students are able to:
 - Know importance and scope of plant physiology.
 - Understand the plants and plant cells in relation to water.
 - Learn about the movement of sap and absorption of water in plant body.
 - Understand the plant, growth, flowering, movement, light response, dormancy and germination.
 - Understand the process of photosynthesis in higher plants with particular emphasis on light and dark reactions, C3 and C4 pathways, respiration in higher plants with particular emphasis on aerobic and anaerobic respiration, ATP synthesis and nitrogen metabolism.
 - **SEC2 – Ethnobotany (BOTSSEC02M)**
 - On completion of the course, students are able to:
 - Know about history and relevance of herbal drugs in Indian system of medicine
 - Learn the macroscopic and microscopic characters, chemical constituents, adulterants, therapeutical and pharmaceutical uses of medicinal plants
 - Understand the techniques for drug evaluation (Chemical, Physical and Biological), Phytochemical investigations, standardization and quality control of herbal drugs
 - Know the technique of medicinal gardening - Cultivation practices, marketing and utilization of selected medicinal plants
- **Semester V**
 - **DSE1- Cell and Molecular Biology(BOTGDSE01T, BOTGDSE01P)**
 - On completion of the course, students are able to:
 - Learn principles of microscopy, Prokaryotic and eukaryotic cell, structure and functions of cell organelles, cell cycle, cell division, DNA packaging, replication, RNA synthesis and processing, transcription regulation.
 - Able to identify cell organelles, stages of cell division, levels of DNA packaging.
 - **DSE2 - Research Methodology (BOTGDSE02T, BOTGDSE02P)**
 - On completion of the course, students are able to:
 - Understand definition and types of research; Research methods vs methodology; Literature-review; Library research; field research;

laboratory research; Key biology research areas, Model organisms in biology; Units of measurements; abbreviations and nomenclature used in scientific writing

- Able to perform common calculations in botany laboratories; maintain a laboratory record, do tabulations and generate graphs, images with proper scales; prepare specimens for reagents for plant specific studies; Writing references; Present a Powerpoint presentation and Poster presentation.
- Understand the details on the label of reagent bottles. Identify common toxic chemicals and safety measures in their handling. Scientific writing and ethics; copyright,academic misconduct/plagiarism.

- **Semester VI**

- **DSE2 - Bioinformatics (BOTGDSE03T, BOTGDSE03P)**

- On completion of the course, students are able to:
- Learn about scope, branches and Research areas of Bioinformatics, Aim, Scope and of Bioinformatics; Biological Databases, information submission to and retrieval from databases.
- Able to handle and analyze nucleic acid and protein sequences, perform multiple sequence alignments, and Phylogenetic Analyses using different computational tools.
- Learn about applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

- **DSE3 - Analytical Techniques in Plant Sciences (BOTGDSE04T, BOTGDSE04P)**

- On completion of the course, students are able to:
- Learn about principles of different types of microscopy; types of centrifugation, spectrophotometry, chromatography; techniques of characterization of proteins and nucleic acids; use of radioisotopes in biological research; preliminary biostatistics.
- Able to use electrophoresis and Blotting techniques for DNA, RNA, and, protein characterization, paper chromatography for nitrogenous bases separation by, layer chromatography for sugar separation, prepare slides for microscopic studies.