Graduate attributes in Botany

The key attributes of a botany honours graduate may include the following:

Fundamental aptitude: Botany graduates are anticipated to possess a comprehensive understanding of the fundamental principles and theories in the field of botany and plant science. These essential concepts are based on the most current knowledge in the field that are subject to change. They need to be revised regularly and within specific timeframes.

Communication skills: To demonstrate a proficiency in communication that meets the minimal levels expected of a scientific graduate in the country. They are required to comprehend and grasp materials including comprehensive analysis and coherent arguments. Graduates are required to possess a high level of proficiency in articulating and conveying their ideas, findings, and concepts to a broad audience.

Thinking ability: Botany graduates are required to hold a solid understanding of critical thinking, which includes knowledge of cognitive biases, mental models, logical fallacies, scientific methods, and the ability to develop well-reasoned scientific arguments.

Psychological capacity: To have fundamental psychological aptitude necessary to confront the broader society, as well as the ability to interact with individuals and pupils from diverse sociocultural, economic, and educational backgrounds. Psychological skills encompass several techniques such as feedback loops, self-compassion, self-reflection, goal-setting, interpersonal interactions, and emotional control.

Problem-solving attitude: They are expected to possess problem-solving methodologies that are applicable across various fields of study, such as Occam's Razor.

Analytical observant: Able to construct persuasive arguments and identify logical fallacies, contradictions, circular reasoning, and other faults in erroneous arguments.

Research skills: Having a strong ability to carefully observe and analyse their natural environment, fostering a sense of curiosity. Graduates are required to create a scientific experiment using statistical hypothesis testing and other forms of a priori reasoning, such as logical deduction.

Collaboration: Possessing the ability to work effectively in teams, fostering constructive partnerships with individuals from various socio-cultural backgrounds.

Digital Literacy: Keeping digital literacy skills in order to participate in and enhance their core competency through e-learning resources such as MOOCs and other digital platforms for lifetime learning. Graduates should possess the ability to identify instances of data fabrication and fake news through the application of logical scepticism and analytical reasoning.

Moral and ethical consciousness: To exhibit responsibility as citizens of India and possess a comprehensive understanding of the moral and ethical standards upheld by the country and the global community. They are expected to clearly articulate their fundamental ethical principles with sufficient precision in order to differentiate between actions that are deemed illegal and criminal according to the Indian constitution. Priority should be placed on academic and research ethics, encompassing equitable Benefit Sharing, Plagiarism, Scientific Misconduct, and other related areas.

Leadership preparedness: Having knowledge of the decision-making process and fundamental managerial abilities in order to enhance their leadership capabilities. Skills may encompass the ability to articulate a clear and compelling aim, vision, and mission, as well as the capacity to cultivate charisma and inspire others as a leader.

Program Learning Outcomes (POs) in B.Sc (Honours) Botany

The student who completes their studies with a Bachelor of Science (Honours) degree in Botany should be able to-

- Develop a strong foundation in the subject of Botany, as well as related subject areas, ensuring their fundamental competency in these fields. The students will demonstrate the capability to

    i. Categorise primary plant groups and analyse the distinguishing features of lower (e.g. algae and fungus) and higher (angiosperms and gymnosperms) plants.

    ii. Utilise the evidence-based comparative botany approach to elucidate the evolution of organisms and comprehend the genetic diversity present on Earth.

    iii. Elucidate diverse plant processes and functions, metabolic activities, notions of genes and genome, as well as how the functioning of organisms is impacted at the cellular, tissue, and organ levels.

    iv. Acquire comprehension of the concepts of adaptation, development, and behaviour as they pertain to various life forms.

    v. Comprehend the interrelationships of life on Earth and to trace the flow of energy through nutrient cycles.

- Showcase their proficiency in the experimental techniques and methodologies specific to their specialised field of Botany.

- Demonstrating their analytical proficiency i.e. their expertise in comprehending research and resolving practical issues.

- Utilize scientific methodologies to solve varied questions which involves establishing hypotheses, collecting data, and critically analysing the facts to determine the extent to which their scientific work corroborates their hypotheses.

- Develop enhanced critical thinking skills and acquire problem-solving aptitudes. Students will be gaining a deeper comprehension of fundamental concepts and their practical applications in scientific principles.

- Be advanced with digital skills and integrate core principles with modern technologies.

- Improve their ethical and moral views and develop the ability to address psychological vulnerabilities.

- Acquire collaboration and cooperation skills to work as a team thereby effectively contributing to institutions, industry, and society.
- Establish themselves as independent learner by gaining subject-specific abilities. In the field of botany, the programme outcome will provide information and skills that may be applied to pursue higher education, competitive tests, and employment opportunities. An outcomes-based curriculum would guarantee uniform academic standards across and provide a comprehensive assessment of students' abilities.

Core Course for B.Sc Botany (Hons.)

Sl. No.	POs	CC-1	CC-2	CC-3	CC-4	CC-5	CC-6	CC-7	CC-8	CC-9	CC-10	CC-11	CC-12	CC-13	CC-14
1	Develop a strong foundation in the subject	√	√	√	√	√	√	√	√	√	√	√	√	√	√
2	Showcase the proficiency in the experimental techniques	√	√	√	√	√	√	√	√	√	√	√	√	√	√
3	Demonstrating the analytical proficiency	√	√	√	√	√	√	√	√	√	√	√	√	√	√
4	Utilize scientific methodologies to solve varied questions	√	√	√	-	√	-	√	√	-	√	√	√	√	√
5	Develop enhanced critical thinking skills	√	√	√	√	√	√	√	√	√	√	√	√	√	√
6	Be advanced with digital skills	-	-	-	-	-	-	-	-	-	√	√	√	√	√
7	Improve their ethical and moral views	-	√	-	√	√	√	√	√	√	√	√	√	√	√
8	Acquire collaboration and cooperation skills to work as a team	√	√	√	√	√	√	√	√	√	√	√	√	√	√
9	Establish themselves as independent learner	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Discipline Specific Electives (DSE) and

Skill Enhancement Course (SEC) for B.Sc. Botany (Hons.)

Sl. No.	POs	DSE-A1	DSE-A2	DSE-B1	DSE-B2	SEC-A	SEC-B
1	Develop a strong foundation in the subject	√	√	√	√	√	√
2	Showcase the proficiency in the experimental techniques	√	√	√	√	-	-
3	Demonstrating the analytical proficiency	√	√	√	√	√	√
4	Utilize scientific methodologies to solve varied questions	√	-	√	√	√	√
5	Develop enhanced critical thinking skills	√	√	√	√	√	√
6	Be advanced with digital skills	-	-	-	-	-	-
7	Improve their ethical and moral views	√	√	√	√	√	√
8	Acquire collaboration and cooperation skills to work as a team	√	√	√	√	√	√
9	Establish themselves as independent learner	√	√	√	√	√	√

Course Learning Outcomes (CLO)

Core Courses

CC-1. Phycology and Microbiology (BOT-A-CC-1-1-TH, BOT-A-CC-1-1-P)

Students will be able to:

- Acquire an understanding of the idea of microbial nutrition.
- Classify viruses according to their characteristics and structures
- Acquire an in-depth knowledge of plant diseases and the treatments available for managing them.
- Investigate the general properties of bacteria as well as their cell reproduction and recombination.
- Raise understanding and appreciation of human-friendly viruses, bacteria, and algae, as well as their economic significance.
- Carry out experiments using skills that are relevant to the subdivisions.

CC-2. Mycology and Phytopathology (BOT-A-CC-1-2-TH, BOT-A-CC-1-2-P)

The course will enable the students to -

- Identify true fungi and illustrate the concepts of plant pathology as well as its application in the management of plant diseases.
- Exhibit proficiency in the various aspects of mycology and plant pathology, including work in the laboratory, the field, and the glasshouse.
- Acquire an understanding of bacteria, fungus, and lichens, as well as a curiosity for the adaptive characteristics of these organisms.
- Determine which plant diseases are most prevalent in accordance with the geographical locations and the equipment used for disease control.

CC-3. Plant anatomy (BOT-A-CC-2-3-TH, BOT-A-CC-2-3-P)

On successful completion of the course, students will be able to

- Develop an awareness of the ideas and fundamentals of plant internal structure.
- Study the internal anatomy underlying plant systems and organs.
- Acquire a critical grasp of the development of the ideas behind the organization of the root apex and the shoot.
- Conduct an investigation of the composition of various plant sections and the interactions between them.
- Conduct an analysis of the capacities of plants to adapt and protect themselves.

CC-4. Archegoniate (BOT-A-CC-2-4-TH, BOT-A-CC-2-4-P)

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

- Demonstrate a grasp of archegoniatae, bryophytes, pteridophytes, and gymnosperms.
- Acquire an in-depth knowledge of the morphology, anatomy, and reproduction procedures of bryophytes, pteridophytes, and gymnosperms
- Understand the evolution of plants and how they adapted to their new habitat.
- Proficiently demonstrate the appropriate experimental techniques and methods for analysis of the Bryophytes, Pteridophytes, and Gymnosperms.

CC-5. Palaeobotany and Palynology (BOT-A-CC-3-5-TH, BOT-A-CC-3-5-P)

The course will enable the students to:

- Demonstrate the fundamentals of plant fossils and conditions of fossilisation.
- Understanding of fossil pteridophytes and their role in plant evolution studies.
- Acquire a grasp of megafossil assemblages in Indian Gondwana system.
- Develop critical understanding on pollen structure and morphology
- Demonstrate proficiency in the experimental techniques and methods of applied palynology viz. forensic palynology, aeropalynology, melissopalynology etc.

CC-6. Reproductive biology of Angiosperms (BOT-A-CC-3-6-TH, BOT-A-CC-3-6-P)

On completion of the course, the students will be able to-

- Understand the fundamental processes of the fertilization in angiosperm
- Analyze and recognize the different organs of plant involved in reproduction.
- Evaluate the structural organization of flower and the process of pollination.
- Understand the concept and evidences of Apomixis & Polyembryony.

CC-7. Plant systematic (BOT-A-CC-3-7-TH, BOT-A-CC-3-7-P)

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

- The theory of plant systematics and recognize the significance of herbarium and virtual herbarium
- Evaluate the importance of herbaria and botanical gardens
- Interpret the rules of ICN in botanical nomenclature
- Learn the concepts associated with Numerical taxonomy and Phylogenetic classification.
- Generalize the characteristics of the families under the classification scheme developed by Bentham and Hooker.
- Grasp practical knowledges to the collection, systematic study and identification of plants.

CC-8. Plant geography, Ecology and Evolution (BOT-A-CC-4-8-TH, BOT-A-CC-4-8-P)

With the help of this course, students will be able to -

- Understand fundamental concepts of biotic and abiotic systems
- Analyze the phytogeography or phytogeographical division of India
- Understand the cornerstones of ecological systems and community ecology
- Evaluate the process of adaptation of plants, succession stages, and phytoremediation.
- Conduct experiments using skills that are appropriate to estimate environmental health.
- Acquire an understanding of the ideas of natural selection and the mechanisms that underlie evolution.

CC-9. Economic Botany (BOT-A-CC-4-9-TH, BOT-A-CC-4-9-P)

Students will be able to –

- Develop a fundamental understanding of economic botany and be able to link to the environment, populations, communities, and biological ecosystems.
- Gain an in-depth comprehension of the development of the concept of organization of apex new crops and varieties, the significance of germplasm diversity, and the problems associated with access and ownership.
- Have a fundamental understanding of the taxonomic diversity and notable families of plants that are of practical utility.
- Raise people's awareness of and appreciation for the plants and plant products that they come into contact with in their daily lives.
- Recognize the wide variety of plant species and the varieties of plant products that are used by humans.

CC-10. Genetics (BOT-A-CC-4-10-TH, BOT-A-CC-4-10-P)

Following the course, students will be able to -

- Have a conceptual knowledge of the rules of inheritance, the genetic foundation of loci and alleles, and the linkage between them.
- Possess an understanding of the impact that chromosomal abnormalities have on structural changes that will ultimately result in genetic diseases.
- Acquire a profound comprehension of the molecular foundations of genes and how they interact with one another at both the population and evolutionary levels.
- Conduct research into the impact that mutations have on the functions and dosage of genes.
- Investigate the function, structure, and replication of the DNA molecule.

CC-11. Cell and Molecular biology (BOT-A-CC-5-11-TH, BOT-A-CC-5-11-P)

Students will be able to:

- Analyze the structural and chemical characteristics of DNA and RNA through an array of earlier experiments.
- The primary categories of prokaryotes can be distinguished from one another.
- Conduct an analysis of the experiments that aim to establish the central dogma and the genetic code.
- Acquire an overall comprehension of the different steps involved in the processes of transcription, protein synthesis, and protein modification.
- Understand various methods of recombinant DNA technology.

CC-12. Biochemistry (BOT-A-CC-5-12-TH, BOT-A-CC-5-12-P)

On completion of the course, the students will be able to-

- Understand the basics of various covalent and non-covalent bonds, properties of water, pH and buffer
- Comprehend different fundamental concepts related to biomolecules such as DNA, RNA, Protein, Lipids etc.
- Analyze the structure and properties of various enzymes including priciples of thermodynamics
- Evaluate the process of membrane transport, phosphorylation and ATP Synthesis

CC-13. Plant Physiology (BOT-A-CC-6-13-TH, BOT-A-CC-6-13-P)

This course will enable the students to –

- Acquire an understanding of the relationship between water and plants in regard to the various physiological processes.
- Have an insight to the process of organic translocation highlighting the mass-flow (pressure flow) hypothesis
- Provide an explanation of the chemical features and symptoms of deficiency in plants.
- Determine the difference between dormancy and germination occurring in plants

CC-14. Plant Metabolism (BOT-A-CC-6-14-TH, BOT-A-CC-6-14-P)

Following successful completion of this course, the students will be able to

- Determine the difference between aerobic and anaerobic respiration
- Discuss the significance of photosynthesis and respiration
- Recognize the significance of carbon assimilation in photorespiration
- Demonstrate the process of ATP synthesis
- Differentiate between anabolic and catabolic routes of metabolism
- Understand the biological process of nitrogen fixation in the metabolic process.

SEC-A. Applied Phycology, Mycology and Microbiology (BOT-A-SEC-A-3-1)

The course will enable the students to –

- Assess the ways in which algae and algal products can be used as source of food and fuel.
- Gain an insight of the various processing steps for the production of enzymes, amino acids, vitamins and antibiotic etc. using applied mycological and microbiological techniques.
- Know the role of microbes as biofertilizer and biopesticides and in mineral processing.

SEC-B. Plant Breeding (BOT-A-SEC-B-4-3)

On completion of this course, students will be able to:

- Gain a conceptual grasp of gene banks, gene pools, plant breeding, and plant genetic resources.
- Learn about the genetic foundation of heterosis.
- Describe the events of inbreeding and inbreeding depression.
- Know the principles of Molecular Breeding and use of DNA markers in plant breeding
- Consider the function of several non-conventional crop development techniques.

DSE-A1. Industrial and Environmental Biology (BOT-A-DSE-A-5-2-TH, BOT-A-DSE-A-5-2-P)

Following the course, students will be able to –

- Recognize the idea of microbes and their function in the environment and industry.
- Examine the different kinds of bioreactors and the fermentation process critically.
- Assess the function of bacteria in agriculture and microorganisms in industrial sector.
- Contemplate various landscaping practices and garden design.
- Gain knowledge about the remediation of contaminants in the soil.

DSE-A2. Medicinal and Ethnobotany (BOT-A-DSE-A-6-3-TH, BOT-A-DSE-A-6-3-P)

Students completing the course will be able to –

- Be familiar with the fundamental pharmacognosy and its importance in modern medicine, crude drugs and Classification of drugs.
- Have in depth knowledge on pharmacologically active constituents and biosynthesis of various secondary metabolites.
- Learn the procedure of chemical, microscopic and histochemical tests for identification of medicinal herbs.
- Propose new strategies to implement the knowledges of ethnomedicine, taking into consideration the practical concerns that are relevant to India.

DSE-B1. Horticultural practices and Post Harvest Technology (BOT-A-DSE-B-5-6-TH, BOT-A-DSE-B-5-6-P)

The course will enable the students to -

- Acquire an understanding of the concept of many types of horticultural techniques for the purpose of adding value.
- Visualize the post-harvest challenges that are likely to be encountered.
- Be familiar with the tricks of the trade and how to increase the longevity of the food.
- Learn different methods for the conservation of genetic resources related to horticultural plants including the role of micropropagation and intellectual property rights etc.

DSE-B2. Natural resource management (BOT-A-DSE-B-6-8-TH, BOT-A-DSE-B-6-8-P)

On completion of the course, students wil be able to –

- Gain an insight of the various ideas that are associated with the natural resources and ecological dynamics
- Conduct an analysis of multi-disciplinary approaches that are related to ecological, economic, and social elements for sustainable development
- Assess the ways in which environmental issues are explained and solutions are found
- Learn various measures to estimate the biodiversity status of a region and their protection strategies.
- Know the national and international initiatives that are being taken to maintain the sustainable ecosystem.

Course credits summary

Course	Credits		
	Theory	**Practical**	**Total**
CC-1. Phycology and Microbiology	04	02	06
CC-2. Mycology and Phytopathology	04	02	06
CC-3. Plant anatomy	04	02	06
CC-4. Archegoniate	04	02	06
CC-5. Palaeobotany and Palynology	04	02	06
CC-6. Reproductive biology of Angiosperms	04	02	06
CC-7. Plant systematics	04	02	06
CC-8. Plant geography, Ecology and Evolution	04	02	06
CC-9. Economic Botany	04	02	06
CC-10. Genetics	04	02	06
CC-11. Cell and Molecular biology	04	02	06
CC-12. Biochemistry	04	02	06
CC-13. Plant Physiology	04	02	06
CC-14. Plant Metabolism	04	02	06
SEC-A. Applied Phycology, Mycology and Microbiology	02		02
SEC-B. Plant Breeding	02		02
DSE-A1. Industrial and Environmental Biology	04	02	06
DSE-A2. Medicinal and Ethnobotany	04	02	06
DSE-B1. Horticultural practices and Post Harvest Technology	04	02	06
DSE-B2. Natural resource management	04	02	06