PGK Mandal's

Haribhai V. Desai College of Arts Science and Commerce, Pune-02

(Autonomous)

Undergraduate Degree Program in Botany (B.Sc. Botany)

(Faculty of Science & Technology)

Revised Syllabi as per National Education Policy (2020) for

F.Y.B.Sc. Botany (Semester-I and II)

To be implemented from

Academic Year 2025-2026

Framed by

BOARD OF STUDIES IN BOTANY

Haribhai V. Desai College,

596 Badhwar Peth Pune -411002

AIMS AND OBJECTIVES

- To develop employability oriented diversified course content.
- To introduce skill oriented specialized education by introducing in-depth learning concepts.
- To expose students to the process of systematic academic inquiry and exhibiting courtesy to the vast universe of basic and applied knowledge of plants.

PROGRAM OUTCOMES (POS)

According to NEP-2020 criteria, the Undergraduate degree in Botany (F.Y.B.Sc. Botany) program at Haribhai V. Desai College, Pune's associated colleges, is structured to provide students with advanced field-related knowledge and essential fundamentals. Through a unique combination of required major core courses with in-depth exposure to multidisciplinary minor, elective, and vocational skill courses, among other courses, students will be trained and acquire the fundamental and advanced knowledge essential to the plant sciences industries.

With the knowledge gained in the field of plant sciences, this upgraded curriculum will develop educated, outcome-oriented candidates who are nurtured through discovery and learning, equipped with practice and skills to deal with practical problems, and competent with recent pedagogical trends in education, including E-learning, flipped class, hybrid learning, and experiential learning. These candidates will become responsible citizens, transforming the nation to lead the world in the future.

After successful completion of the Undergraduate (UG) Degree program, the students would be able to:

PO1: Attain thoughtful proficiency in the field of plant sciences.

PO2: Acquire the ability to perform in multidisciplinary domains.

PO3: Attain the ability to exercise intelligence of scientific knowledge for investigation and innovation and nourishment of the world.

PO4: Learn value based ethical practices and principles committed to professional ethics.

PO5: Incorporate 21st century skill oriented self-directed and life-long learning.

PO6: Obtain ability to inculcate the knowledge of plant science in diverse contexts with global perspective.

PO7: Attain maturity to harness the destiny and responds to one's calling.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Recall the diversity, classification, evolution and developmental changes among the plants with reference to lower and higher plant groups and create a knowledge base

in understanding the basis of plant diversity, economic values and taxonomy of plants.

PSO2: Understand the advanced concepts of Genetics, Cell biology and Plant Biotechnology of plants and its implementation for the improvement of crop productivity.

PSO3: Acquire and utilize the skills of post-harvest, flower design, fruit processing and dehydration techniques, organic farming and various plant processing technologies for developing the economy to the growing world.

PSO4: Know about the importance of Medicinal plants and its useful parts, economically important plants in our daily life and about the traditional medicines and herbs, and its relevance in modern times.

PSO5: Inculcate the methodology followed in plant breeding, pharmacognosy, herbal drug technology, plant protection, propagation and improvement.

PSO6: Adapt methods of scientific research in plant improvement program and create entrepreneurships, employment to the society.

PSO7: Analyze the impact of scientific and technological advances on the environment and society and understand the importance of biodiversity conservation, green cover development, carbon sequestration and utilize the knowledge for sustainable development.

PSO8: Explore the knowledge of biotic and abiotic stress tolerance, plant microbe interaction and Integrate pest management for making the revolution in the agriculture.

PSO9: Enrich the ability of critical thinking, development of scientific attitude, handling of problems and generating solutions, improve practical skills, and enhance communication skill.

PSO10: Apply the fruitful knowledge of plant sciences and plant resources for the sustainable development, betterment of society and environment by recognizing the ethical values.

PSO11: Become competent enough in various analytical and 21st century technical skills related to plant sciences for their exploration.

PSO12: Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.

PSO13: Employ critical thinking-based problem solving and practical skills pertaining to botanical techniques and computational knowledge and apply strategies for environmental conservation.

PSO14: Demonstrate knowledge and scientific understanding to identify research problems, design experiments, use appropriate methodologies, analyze and interpret

data and provide solutions. Exhibit organizational skills and the ability to manage time and resources.

1. Title of the Course: B.Sc. Botany (03 years) / B.Sc. with Honor's in Botany (04 years)

Syllabus revised as per National Education Policy (NEP) 2020 for the Haribhai V. Desai College, Pune

2. Faculty - Science and Technology

3. To be implemented -For F.Y.B.Sc. (Semester I and Semester II), from Academic Year 2025-26

4. Preamble -

Plants are the sole true foundation for all scientific disciplines since they create all kinds of ecosystems and are necessary for all other life forms on Earth to survive. Through both basic and applied research, the study of botany has a significant potential to assist the nation in achieving its sustainable goals. The world's overpopulation is having a concerning effect on the development and productivity of food (particularly plants), in addition to the ever-increasing challenges of environmental contamination brought on by unfavorable climatic changes, global warming, and natural disasters.

Botany is the only supreme foundation of all sciences, because plants, as producers of all kinds of ecosystems, play a critical role in the survival and existence of all other living things on the planet. Botany has tremendous potential for achieving the nation's long-term goals by utilizing it at both the basic and applied levels. In the current scenario, the world's overpopulation, combined with the day-by-day increasing problems of environmental pollution caused by adverse climatic changes, global warming, and natural calamities, is severely affecting the growth, development, and productivity of produce (particularly plants) to alarming levels.

Higher education in plant sciences should be encouraged for students with backgrounds in the life sciences, with an emphasis on applying the most recent data, expertise, and abilities from both basic and applied branches to develop solutions for sustainable development. Considering this curriculum has been designed to equip students with the knowledge and skills they will need to handle problems pertaining to the needs and worries of both the environment and the human population. In order to accomplish these goals, every effort is made to guarantee high standards of education by implementing numerous strategies to enhance the teaching-learning process, assessment and evaluation methods, and making sure that students are developed holistically in line with the goalsand standards of NEP 2020.

The thoughtfully crafted F.Y.B.Sc. Botany curriculum combines a focus on subjects linked to advanced agriculture, the plant-based industry, and pharmaceutical companies with a deep comprehension of the subject's fundamental concepts. This will inspire and attract life science students to seek M.Sc. and Ph.D. degrees in botany in order to become prosperous entrepreneurs, proficient workers, or sophisticated farmers who can address social and environmental issues as a part of sustainable development.

The National Education Policy (NEP-2020), which is being implemented by the Ministry of Higher Education, the Government of India, and the University Grants Commission (UGC), offers opportunities for developing 21st century advanced skills based on the Indian knowledge system through research internships with renowned and esteemed faculty and researchers at their own or other HEIs / research institutes. Additionally, it acknowledges, pinpoints, and nurtures each student's distinct talents in order to support their overall growth and strengthen the country. This will empower Indian youngsters in the field of plant sciences globally and assist the country establish a solid foundation on the global market. Our nation boasts the highest percentage of young people, who, after receiving a top-notch education, have the potential to govern the world in the years to come.

In order to address problems pertaining to plant sciences, such as biodiversity conservation, soil health, plant nutrition, plant wealth and plant-based resource management, interactions between plants and microorganisms, plant pathogens and diseases, and carbon sequestration, the B.Sc. Botany curriculum offers a thorough theoretical and practical knowledge base. In the exploration of plant sciences, students will be able to stand independently and with confidence.

Program Duration and Exit Options

The UG Program lasts for four years or eight semesters.

A student may leave the program after the third year if he/she would like to receive a three-year undergraduate degree.

If the student decides to withdraw after the first or second year, he/she will receive a UG Certificate or UG Diploma, depending on how many credits he/she is able to complete. Re-entering within three years to finish the degree program is allowed for students who leave with a UG certificate or UG diploma. A student must earn a minimum of 18 credits and a maximum of 26 credits each semester. It is recommended, nevertheless, that students should opt for 22 credits per semester. This clause aims to give students the comfort of a flexible semester-based course load. However, Table 1 lists the minimum number of credits

required to be earned in order to be awarded an Undergraduate Certificate/Undergraduate Diploma/Bachelor Degree/Bachelor's Degree with Honors in Botany.

Table1: Type of Awards and Stages of Exit

Sr. No.	Type of Award	Stage of Exit	Mandatory Credits
1.	Undergraduate Certificate in Botany	After successful completion of First year Semesters	44
2.	Undergraduate Diploma in Botany	After successful completion of Second year Semesters	88
3.	Bachelor of Science in Botany	After successful completion of Third year Semesters	132
4.	Bachelor of Science in Botany (Honours)	After successful completion of Fourth year Semesters	176

5. Eligibility Criteria -

The basic criteria for Undergraduate Degree (F.Y.B.Sc. Botany) admission will be 10+2 criteria with Biology, Physics, Chemistry, Mathematics, and Geography as Principal subjects OR MCVC OR Diploma courses related to Plant Sciences. Admissions will be givenas per the selection procedure / policies adopted by the college keeping in accordance with the conditions laid down by the Savitribai Phule Pune University, Pune. Reservation and relaxation are as per the State Government rules.

6. Fee Structure – As per the norms of Haribhai V. Desai College, Pune.

7. Duration of the Course

Certificate Course- 01-year (Completion of 02 Semesters)Diploma Course- 02 years (Completion of 04 Semesters) BSc Degree- 03 years (Completion of 06 Semesters)

BSc Degree with Honours- 04 years (Completion of 08 Semesters)

8. No. of semesters – Two semesters per year

9. Medium of instructions and teaching: English

10. Course Implementation criteria for Theory and Practical:

a. Each semester comprises of 15 weeks (12 weeks Actual Teaching + 3 weeks for Continuous Internal Evaluation).

b. One Credit of the Theory is equal to15 clock hours (Teaching 1 hour per week for each credit, 12 hours Actual Teaching + 3 hours Continuous Internal Evaluation – Assignments, Tutorials, Practice, Problem solving sessions, Group discussion, Seminars and Unit Tests.

c. One Credit of Practical = 30 clock hours. (2 Contact hours per credit per week)

One Credit = 30 clock hours (24 hours' Actual Table work + 6 hours for journal

competition, and Continuous Internal Evaluation of each practical).

d. Practical for each course comprises of 02 Credits = 60 clock hours. Therefore,

- Minimum 12 laboratory sessions of 04 clock hours must be conducted in one semester.
- In case of short practical, two practicals should be conducted in one session.
- Each practical of 04 clock hours in the laboratory should consist of: Table performance for concerned practical, careful observations, calculation, writing results and conclusion, and submission of practical in written form.
- Pre-laboratory reading and post laboratory assignments should be given on each practical as a part of continuous internal evaluation.

11. Examination Pattern (For each Semester): The examinations will be conducted semester wise for both Theory as well as Practical courses.

- **Theory Paper of 02 Credits -**
  - Internal Exam (15 M) + College Theory Exam (35 M) = Total 50 M
  - Duration: For Internal exam = 40 Min. and For College Theory Exam = 02 hours.
- **Practical Paper of 2 Credits -**
  - Internal Exam (15 M) + College Practical Exam (35 M) = Total 50 M
  - Duration: For Internal exam = 40 Min. and College practical Exam = More than 04 hours.

12. Award of Class/Grade: The class / grade for the courses of each semester will be followed as per the norms and conditions laid down by Haribhai V. Desai College, Pune.

13. ATKT Rules: As per the norms given by Haribhai V. Desai College, Pune.

14. Important Note:

a. There shall be at least a short tour/field visit/industrial visit (1-2 days) per year for all UG students. Tours are part of the curriculum and obligatory to each student, failing which they will not be considered eligible to appear for the practical examination. Under unavoidable circumstances, if the student fails to attend the tour, he/she has to produce justifiable evidence for not attending the tour. However, in lieu of tour the candidate will have to complete the work assigned by the Department.

c. The documents to be produced by each student at the time of practical examination (at the end of each Semester) are:

- Submission of practical records (Journals).
- Submission of a Tour / Visit report duly signed by the concerned practical In-charge and Head of the Department.
- Any submissions / assignments, etc. based on the practical course.

Question paper pattern for Theory (2 Credit courses)

A student will have to solve a question paper with 35 marks. The paper setter should set the paper on entire syllabus for total 61 marks, including optional questions. As the course is of 2 Credits (30 clock hour lectures), paper setter should allot 2.03 marks per lecture and accordingly, questions should be set for 30 lectures, 61 marks on entire syllabus.

Note: All questions are compulsory.
Time: 2 Hours

Que. 1) Answer any five of the following in one sentence 05 Marks

- Six questions
- Each for 1 mark

Que. 2a) Write any one of the following 06 Marks

i.
ii.

Que. 2b) Write any one of the following 04 Marks

i.
ii.

Que. 3a) Solve any one of the following 06 Marks

i.
ii.

Que. 3b) Solve any one of the following 04 Marks

i.
ii.

Que. 4) Write notes on (Any four) 10 Marks

a.
b.
c.
d.
e.
f.

CREDIT FRAMEWORK FOR F.Y.B.Sc. BOTANY, SEMESTER – I and II (Level 4.5 / 100)

SEMESTER I			
COURSE DETAILS	**COURSE CODE**	**COURSE TITLE**	**CREDITS**
Subject 1 – (1T + 1P) x 2 C = 4 C	BOT-101-TH	Basic and Applied Plant Science	**2 C**
	BOT-102-PR	Practical Based on BOT-101-TH	**2 C**
Subject 2 – (1T + 1P) x 2 C = 4 C	Subject 2 -T	------	**2 C**
	Subject 2 -P	------	**2 C**
Subject 3 – (1T + 1P) x 2 C = 4 C	Subject 3 -T	------	**2 C**
	Subject 3 -P	------	**2 C**
Skill Enhancement Courses (SEC) – (1T / 1P = 2 C) (Anyone from basket)			**2 C**
	SEC-103-BOT-PR	Algal Technology	
Indian Knowledge Systems (IKS) – (1T = 2 C)	IKS-101-T	Generic	**2 C**
Ability Enhancement Course (AEC) – (1T = 2 C)	AEC-101-ENG-T	English	**2 C**
Value Education Courses (VEC) – (1T = 2 C)	VEC-101-ENV-T	Environmental Awareness	**2 C**
		Total Credits (V1+V2+V3+V4+V5+V6)	**22 C**
SEMESTER – II			
Subject 1 – (1T + 1P) x 2 C = 4 C	BOT-151-TH	Basics of Plant Sciences	**2 C**
	BOT-152-PR	Practical Based on BOT-151-TH	**2 C**
Subject 2 – (1T + 1P) x 2 C = 4 C	Subject 2 -T	------	**2 C**
	Subject 2 -P	------	**2 C**
Subject 3 – (1T + 1P) x 2 C = 4 C	Subject 3 -T	------	**2 C**
	Subject 3 -P	------	**2 C**
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Anyone from basket)			**2 C**
	SEC-151-BOT-PR	Plant Propagation Techniques	
Ability Enhancement Courses (AEC) – (1T = 2 C)	AEC-151-ENG-T	English	**2 C**
Value Education Courses (VEC) – (1T = 2 C)	VEC-151-ENV-T	Environmental Awareness	**2 C**
Co-curricular Courses (CC) – (1T = 2 C)	CC-151-T	Any one from basket	**2 C**
		Total Credits (V1+V2+V3+V4+V5+V6)	**22 C**
		Total Credits for FYBSC - Semester I (22 C) + Semester II (22 C)	**44 C**

Exit Option: Award of UG Certificate Course with 44 Credits and an additional 4 Credits core NSQF course / Internship OR Continue with Major and Minor.

Continue option: Student will select one subject among the subject 1, subject 2 and subject 3 as Major and another as Minor and third subject will be dropped.

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Subject 1 – (1T + 1P) x 2 C = 4 C	BOT-101-TH	Basic and Applied Plant Science	**2 C**
	BOT-102-PR	Practical Based on BOT-101-TH	**2 C**
Subject 2 – (1T + 1P) x 2 C = 4 C	Subject 2 -T	------	**2 C**
	Subject 2 -P	------	**2 C**
Subject 3 – (1T + 1P) x 2 C = 4 C	Subject 3 -T	------	**2 C**
	Subject 3 -P	------	**2 C**

F. Y. B. Sc. Botany [Semester - I]
Course Code - BOT-101-TH
Course Title: Basic and Applied Plant Science I
[No. of Credits: 2 C] **[No. of Lectures: 30 L]**

OBJECTIVES:

1. Equip students with the practical skills needed to apply theoretical knowledge in plant sciences to real-world scenarios, such as agriculture, horticulture, and environmental management.
2. Familiarize students with modern techniques and technologies used in plant science research and applications, including genetic engineering, biotechnology, and molecular biology.
3. Enhance students' ability to analyse and solve complex problems in plant sciences, including issues related to crop productivity, pest management, and environmental sustainability.
4. Foster a culture of innovation and creativity among students, encouraging them to explore new ideas and approaches to address challenges in plant sciences and agriculture.

OUTCOMES:

1. Students will be able to apply advanced plant biotechnology techniques, such as genetic engineering and tissue culture, to improve crop productivity, develop genetically modified crops, and produce plant-derived pharmaceuticals.
2. Students will demonstrate the ability to implement and evaluate sustainable agricultural practices, including organic farming, integrated pest management, and the use of biofertilizers, to enhance soil health and crop yields while minimizing environmental impact.
3. Students will be proficient in utilizing precision agriculture technologies, such as remote sensing, GIS, drones, and sensors, to monitor and manage crop health, optimize resource use, and improve overall farm management efficiency.

F. Y. B. Sc. Botany [Semester - I]

Course Code - BOT-101-TH

Course Title: Basic and Applied Plant Science

[No. of Credits: 2 C] **[No. of Lectures: 30 L]**

Sr. No.	Topic Details	No. of Lectures
	Credit I : Credit I – PLANT KINGDOM	**15**
1	**Introduction to Plant Diversity** 1.1 Definition and concept of Plant Diversity. 1.2 General outline of Plant Kingdom. 1.3 Avenues / Career opportunities available to Botanists	**02**
2	**Algae** 2.1 Introduction, definition and characters of Algae, suitable examples. 2.2 Classification of Algae as per G.M.Smith	**02**
3	**Fungi** 3.1. Introduction, definition and general characters of fungi; suitable examples. 3.2. Classification of Fungi as per G.M.Smith	**02**
4	**Lichens** 4.1 Introduction; definition and general characters of lichen 4.2 4.2 Types–crustose, foliose and fruticose.	**01**
5	**Bryophytes** 5.1 Introduction; definition and general characters; suitable examples 5.2 Classification of Bryophytes as per G.M.Smith	**02**
6	**Pteridophytes** 6.1 Introduction; definition and general characters; suitable examples. 6.2 Classification of Bryophytes as per G.M.Smith	**02**
7	**Gymnosperms** 7.1 Introduction; definition and general characters of gymnosperms;suitable examples. 7.2 Classification of Gymnosperms as per K.R.Sporne	**02**
8	**Angiosperms** 8.1 Introduction; definition and general characters of angiosperms;suitable examples. 8.2 Classification of Angiosperms as per Bentham and Hooker's System	**02**

	Credit II	15
6	**Introduction to Applied Plant Science** 6.1 Overview of key concepts and principles 6.2 Importance of applied plant sciences in addressing global challenges.	02
7	**Plant Biotechnology** 7.1 Genetic engineering techniques in crop improvement. 7.2 Plant Tissue Culture for improvement of crop productivity. 7.3 Biopharmaceuticals 7.4 Applications of biotechnology in plant breeding and biotic/abiotic stress tolerance.	04
8	**Precision Agriculture** 8.1. Remote sensing and GIS applications in agriculture. 8.2 Use of drones and sensors for crop monitoring and management.	03
9	**Sustainable Agriculture Practices** 9.1 Organic farming methods and principles. 9.2 Integrated pest management strategies.	03
10	**Plant-Microbe Interactions** 10.1 Role of plant-associated microbes in plant health and productivity. 10.2 Applications of beneficial microbes in agriculture.	03

References:

1. "Principles of Applied Botany" by Mary E. Gressel
2. "Applied Plant Science: Principles and Practices" by Pamela M. Vance and Vance C. Ostolaza.
3. "Soil Science: Principles and Practices" by R.K. Mehra.
4. "Principles of Plant Biotechnology" by P.K. Gupta.
5. "Principles of Weed Science" by S.S. Hundal.
6. "Introduction to Horticulture" by Kumar and Singh.
7. "Plant Physiology" by Pandey and Sinha.
8. "Principles of Agronomy" by S.R. Reddy and G.H. Sankara Reddy.
9. "Plant Breeding: Principles, Methods and Applications" by B.D. Singh.
10. "Postharvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals" by R. Wills, B. McGlasson, D. Graham, and D. Joyce
11. "Plant Nutrition and Soil Fertility Manual" by J. Benton Jones Jr.
12. "Sustainable Agriculture" edited by Eric Lichtfouse
13. "Crop Production: Evolution, History, and Technology" by C. Wayne Smith and Julian R. Smith.
14. "Plant Physiology and Development" by Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy.
15. "Plant Biotechnology and Agriculture: Prospects for the 21st Century" edited by Arie Altman and Paul Michael Hasegawa.
16. "Principles of Plant Genetics and Breeding" by George Acquaah.
17. "Remote Sensing Applications in Agriculture: Opportunities and Constraints" edited by B.S. Bhattacharya and S.K. Ghosh.
18. "Precision Agriculture: Technology and Economic Perspectives" edited by P. Sengupta and S. Shankar.
19. "Precision Farming in Horticulture: Approaches and Applications" edited by Debashis Mandal, V.K. Gupta, and R.N. Pal.
20. "Smart Technologies for Sustainable Smallholder Agriculture: Upscaling in Developing Countries" edited by Justice O. Alabi and Harjit Kaur.
21. "Precision Agriculture: Principles and Applications" edited by Manjit Singh and Rajan Bhatia.

F. Y. B. Sc. Botany [Semester - I]
Course Code – BOT-102-PR
Course Title: Practical Based on BOT-101-TH

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

OBJECTIVES:

1. To equip students with hands-on experience in using essential laboratory instruments and equipment.
2. To provide students with a thorough understanding of the genetic engineering processes.
3. To train students soil health analysis and interpret the results in the context of soil health and sustainable agriculture.
4. To teach students the process of composting organic waste to produce biofertilizer and to evaluate its effectiveness in enhancing soil fertility and plant growth.
5. To demonstrate and practice post-harvest techniques.
6. To organize visits to nurseries and plant-based industries and train students for preparing visit reports to link theory with real-world applications.

OUTCOMES:

1. Students will develop hands-on expertise in using essential laboratory instruments and equipment.
2. Students will gain practical knowledge in demonstrating and evaluating genetically modified crops and evaluate the agronomic performance, environmental impact, and socio-economic benefits of these genetically modified crops.
3. Students will acquire the ability to estimate soil organic carbon using methods like Walkley-Black or similar wet oxidation techniques and interpret the significance of these measurements in soil health and sustainable agriculture.
4. Students will demonstrate the ability to compost kitchen waste and convert it into biofertilizer, highlighting the principles of organic waste management and sustainable recycling.

F. Y. B. Sc. Botany [Semester - I]
Course Code – BOT-102-PR
Course Title: Practical Based on BOT-101-TH

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Sr. No.	Title of the Practical	No. of Practical
1	Introduction to Stains, Mounting Media, Dissection box & Microscopes	1 P
2	Study of life cycle of *Spirogyra* w.r.t. thallus, cell structure and reproduction.	1 P
3	Study of life cycle of *Albugo*/ Cystopus w.r.t. host, occurrence, morphology andreproduction.	1 P
4	Study of forms of lichens based on their external morphology – Crustose, Foliose and Fruticose.	1 P
5	Study of life cycle of *Riccia* w.r.t. external and internal morphology of thallus and reproduction.	1 P
6	Study of *Nephrolepis* w.r.t. external morphology of sporophyte; Internal morphology of rachis and leaflet/ pinna passing through sori.	1 P
7	Study of *Cycas* w.r.t. external morphology of sporophyte; Internal morphology of leaflet / pinna; Reproduction – male and female cone.	1 P
8	Botanical Excursion to nearby locality to study the vegetation anddiversity among various plant groups.	1 P
9	Study of principles, working and practical applications of instruments and equipment used in plant tissue culture - pH meter, Autoclave, Hot air oven, Laminar Air Flow, Micropipettes, Digital One Pan Balance, Glass Distillation Unit).	1 P
10	Demonstration of genetically modified crops – Bt –Cotton, Bt-Maize,Golden Rice, Round-up ready Soybean.	1 P
11	To demonstrate the composting of kitchen waste for the preparation of biofertilizer.	1 P
12	Demonstration of *Azolla* cultivation, nutrition and production attributes and its application as biofertilizer.	1 P
13	To study the effect of Mycorrhiza on growth attributes of crop plants.	1 P
14	Study on preparation of Dashparni Ark and EM solution.	1 P
15	Study of various plant-associated microbes useful in improvement of plant health and productivity – Rhizobia – *Rhizobium*	1 P
16	To demonstrate the post-harvest techniques w.r.t. preparation of amla candy and alepak (Zinger wadi)	1 P
17	Visit to the nursery for the exploration of exotic ornamental plants and preparation of visit report for their application in in-door gardening practices.	1 P

Note: Conduct 07 practicals from Basic Botany and 08 from Applied Botany

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Anyone from basket)			**2 C**
	SEC-103-BOT-P	Algal Technology	

F. Y. B. Sc. Botany [Semester - I]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SEC-103-BOT-PR
Course Title: Algal Technology

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Objectives:

1. Gain an understanding of algal biology, including the diversity of algae species, their classification, and their ecological roles.
2. Learn various techniques for cultivating algae, including open pond systems, closed photo-bioreactors, and hybrid systems, to maximize biomass production.
3. Acquire skills in harvesting algae biomass and processing it into valuable products, such as biofuels, biofertilizers, and nutraceuticals.
4. Understand the potential of algae in bioremediation, including their ability to remove pollutants from water and air, and develop skills in applying algal technology for environmental remediation.
5. Develop skills in the development of value-added products from algae, such as cosmetics, pharmaceuticals, and food additives, to explore the commercial potential of algal technology.

Outcomes:

1. Develop proficiency in cultivating algae using various methods, including open pond systems and photobioreactors, to maximize biomass production.
2. Acquire expertise in harvesting algae biomass and processing it into valuable products, such as biofuels, biofertilizers, and high-value chemicals.
3. Gain knowledge of algal biotechnology techniques, such as genetic engineering and strain selection, to enhance algal productivity and product quality.
4. Develop skills in using algae for bioremediation purposes, including the removal of pollutants from wastewater and the sequestration of carbon dioxide from the atmosphere.
5. Develop the ability to develop innovative algal-based products, such as cosmetics, pharmaceuticals, and functional foods, to meet market demands and promote sustainable development.

F. Y. B. Sc. Botany [Semester - I]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SEC-103-BOT-PR
Course Title: Algal Technology

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Sr. No.	Title of the Practical	No. of Practical
1	To study the methods of collection, preservation and staining of algae.	1 P
2	Study of algae from freshwater bodies.	1 P
3	Study of thallus organization of - Unicellular algae - Non motile: *Chlorella* and Motile: *Chlamydomonas*; Colonial algae - *Volvox*; Filamentous algae: *Anabaena / Spirogyra*; Siphonous algae: *Caulerpa / Chara*; Parenchymatous algae: *Sargasssum / Gracillaria.*	2 P
4	Preparation of culture media for freshwater algae - Bolds Basal medium for Blue Green Algae, Modified Chu-10 medium, Nitsch medium. (Demonstration).	1 P
5	Isolation of algae by dilution and streak culture technique (Demonstration).	1 P
6	Cultivation of *Spirulina.*	1 P
7	Study of commercial products of *Spirulina.*	1 P
8	Utilization of algae in Biofuel, agriculture and pharmaceuticals industries. (Demonstration).	1 P
9	Utilization of algae in food and fodder industry, algae and space research. (Demonstration).	1 P
10	Preparation of culture media for BGA.	1 P
11	Preparation of Blue Green Algae as a Biofertilizers.	1 P
12	Study of wastewater algae.	1 P
13	Study of algal bioluminescence (Demonstration).	1 P
14	Visit to nearby ponds rivers lakes and polluted habitats to study fresh water or marine water algal habitats and submission of visit report.	1 P

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Indian Knowledge Systems (IKS) – (1T = 2 C)	IKS-101-T	Generic	**2 C**
Ability Enhancement Course (AEC) – (1T = 2 C)	AEC-101-ENG-T	English	**2 C**
Value Education Courses (VEC) – (1T = 2 C)	VEC-101-ENV-T	Environmental Awareness	**2 C**

F.Y. B. Sc. Botany
Semester – II

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Subject 1 – (1T + 1P) x 2 C = 4 C	BOT-151-T	Basics of Plant Sciences	**2 C**
	BOT-152-P	Practical Based on BOT-151-T	**2 C**
Subject 2 – (1T + 1P) x 2 C = 4 C	Subject 2 -T	------	**2 C**
	Subject 2 -P	------	**2 C**
Subject 3 – (1T + 1P) x 2 C = 4 C	Subject 3 -T	------	**2 C**
	Subject 3 -P	------	**2 C**

F. Y. B. Sc. Botany [Semester - II]
Course Code - BOT-151-T
Course Title: Basics of Plant Sciences

[No. of Credits: 2 C] **[No. of Lectures: 30 L]**

Objectives:

1. Develop a comprehensive understanding of the concept and importance of plant diversity, including an overview of the plant kingdom and the classification of various plant groups.
2. Gain knowledge about the characteristics, economic importance, and biotechnological applications of algae, including their use in food, industry, and bioremediation.
3. Understand the ecological roles and economic importance of fungi, including their roles in nutrient cycling, symbiotic relationships, and applications in food production and industry.
4. Explore the characteristics, ecological significance, and economic uses of lichen and bryophytes, including their roles in environmental monitoring, soil formation, and horticulture.
5. Gain insight into the characteristics and ecological and economic importance of pteridophytes, gymnosperms, and angiosperms, including their roles in ecosystems, agriculture, and industry.

Outcomes:

1. Students will demonstrate a clear understanding of the definition and concept of plant diversity, including the general outline of the plant kingdom and its major groups.
2. Students will be able to identify and describe the characteristics of algae, and explain their economic and biotechnological importance, including their roles in food, industry, and future research prospects.
3. Students will understand the ecological roles of fungi in nutrient cycling and symbiotic relationships, and recognize their economic importance in industry, agriculture, and food production.
4. Students will identify different types of lichens and bryophytes, and describe their ecological significance and economic uses, including their roles in environmental monitoring and traditional medicine.
5. Students will demonstrate knowledge of the characteristics and importance of pteridophytes, gymnosperms, and angiosperms, including their ecological roles, economic significance, and contributions to ecosystems and human welfare.

F. Y. B. Sc. Botany [Semester - II]

Course Code - BOT-151-T

Course Title: Basics of Plant Sciences

[No. of Credits: 2 C] **[No. of Lectures: 30 L]**

Sr. No.	Topic Details	No. of Lectures
	Credit I - PLANT KINGDOM	**15**
1	**Introduction to Plant Diversity** 1.3 Definition and concept of Plant Diversity. 1.4 General outline of Plant Kingdom. 1.5 Avenues / Career opportunities available to Botanists	**02**
2	**Algae** 2.3 Introduction, definition and characters of Algae, suitable examples. Economic and Biotechnological Importance of Algae – 2.1 Algae as food: nutritional value and culinary uses. 2.1.1 Algae in industry: biofuels, pharmaceuticals, and bioremediation. 2.1.2 Biotechnological applications: algae cultivation, geneticengineering, and algae-based products.	**02**
3	**Fungi** 3.3. Introduction, definition and general characters of fungi; suitable examples. 3.4. Ecological and Economic Importance of Fungi – 3.2.1 Fungi in nutrient cycling and decomposition. 3.2.2 Symbiotic relationships: mycorrhizae, lichens. 3.2.3 Economic importance of fungi in industry and agriculture. 3.2.4 Fungi in food production and fermentation processes.	**02**
4	**Lichens** 5.2 Introduction; definition and general characters of lichen; Types–crustose, foliose and fruticose. 5.3 Importance of Lichen – Ecological significance: contribution to nutrient cycling, soil formation, and erosion control; Role of lichens as bio- indicators of environmental health.	**01**
5	**Bryophytes** 5.1 Introduction; definition and general characters; suitable examples. 5.2 Ecological and Economic Importance of Bryophytes – 5.2.1 Ecological Importance of bryophytes - in Ecosystems, Soil	**02**

	formation and Stabilization, Habitat creation, Water retention and nutrient cycling. 5.2.2 Economic Importance of bryophytes – role of mosses in horticulture and landscaping, traditional and modern uses of bryophytes in medicine, economic value of bryophytes in industries such as forestry and agriculture.	
6	**Pteridophytes** 6.2 Introduction; definition and general characters; suitable examples. 6.3 Ecological and Economic Importance of Pteridophytes – 6.3.1 Ecological Importance of Pteridophytes - Role of Pteridophytes in plant evolution; transition from aquatic to terrestrial habitat; Contribution to ecosystem diversity; Role in soil stabilization and conservation. 6.3.2 Economic Importance of Pteridophytes – Ornamental uses: landscaping and indoor plants; Medicinal uses: traditional and modern applications.	**02**
7	**Gymnosperms** 7.3 Introduction; definition and general characters of gymnosperms;suitable examples. 7.4 Ecological and Economic Importance – Economic significance: timber, paper, resin, ornamental and medicinal uses, etc.	**02**
8	**Angiosperms** 8.3 Introduction; definition and general characters of angiosperms;suitable examples. 8.4 Ecological and Economic importance of Angiosperms: – 8.4.1 Ecological Importance of Angiosperms: Role as Primary producers, in habitat and biodiversity, soil conservation, water regulation; pollinator support. 8.4.2 Economic Importance of Angiosperms: Food, Fodder, Fiber, Medicine, Timber, Ornamental, Horticulture and Landscaping, Biofuel production.	**02**
	Credit II – PLANT MORPHOLOGY INTRODUCTORY ANATOMY	**15**
9	**Introduction to Plant Morphology** 9.1. Introduction, Definition; Types of morphology – Descriptive and Interpretative. 9.2. Importance of Morphology. 9.3. Importance of Anatomy	**02**

10	**Morphology of Inflorescence** 10.1 Definition, Parts of Inflorescence. 10.2 Types of Inflorescences – a) Racemose – i) Main Axis Elongated – Raceme, Spike. ii) Main Axis Shortened – Umbel andCorymb; iii) Main Axis Flattened – Capitate, Head / Capitulum; b) Cymose – Solitary, axillary, Terminal, Uniparous (Monochasial), Biparous (Dichasial), Multiparous (Polychasial) Cyme; c) Special Type – Verticilliaster, Cyathium, Hypanthodium.	**02**
11	**Morphology of Flower** 11.1 Definition, typical structure of flower. 11.2 Types of flowers based on Symmetry, Insertion of floral whorls on thalamus. 11.3 Floral whorls – I) Accessory whorls: a) Calyx: member - sepals, number, cohesion, types of calyces; Modificationsof calyx – Petaloid, Pappus, Spurred. b) Corolla: member – petals: Claw and Limb; number, cohesion, types / forms of corolla – Polypetalous Regular – Cruciform; Polypetalous irregular – Papillionaceous; Gamopetalous Regular – Infundibuliform; Gamopetalous Irregular – Bilabiate. c) Perianth: member – tepals, number, cohesion, modifications – sepaloid and petaloid tepals. Aestivation – Definition; aestivation in calyx, corolla and perianth; types of aestivations. II) Necessary / Essential whorls: a) Androecium: member – stamen, Structure of stamen; Cohesion and Adhesion. b) Gynoecium: member – Carpel / Pistil; structure of carpel; Types of gynoecium based on carpel number and fusion; Placentation- Definition; types.	**05**
12	**Morphology of Fruit and Seed:** Fruit: Definition and parts of fruit.	**01**
	INTRODUCTORY ANATOMY	
13	Introduction to Meristematic Tissues • Definition and characteristics of meristematic tissues • Classification based on position: ➢ Apical meristems ➢ Lateral meristems ➢ Intercalary meristems • Functions and significance in plant growth and development Detailed Classification of Meristematic Tissues • Primary vs. Secondary meristematic tissues • Role of meristematic tissues in plant morphogenesis • Practical examples and case studies in plant tissue analysis	**02**

14	Permanent Tissues - Part I (Simple Tissues) • Overview of permanent tissues and their differentiation from meristematic tissues • Simple Tissues: ➢ Parenchyma: Structure, functions, and occurrence ➢ Collenchyma: Characteristics, role in plant flexibility and support ➢ Sclerenchyma: Properties, mechanical strength, and occurrence Permanent Tissues - Part II (Complex Tissues) • Complex Tissues: ➢ Xylem: Components (tracheids, vessels, fibers, parenchyma), structure, and functions ➢ Phloem: Elements (sieve tubes, companion cells, fibers, parenchyma), functions, and transport mechanisms • Comparative analysis of simple vs. complex tissues in plants	**02**
15	Tissue Systems - The Epidermal Tissue System • Definition and overview of tissue systems • Components of the epidermal tissue system: ➢ Epidermal cells, guard cells, stomata, trichomes ➢ Role in plant protection, gas exchange, and transpiration • Modifications of epidermal tissue in different plant species Practical and Applied Aspects of Plant Tissue Systems • Case studies on tissue system adaptations in various environmental conditions • Overview of tissue functions in plant physiology • Applications of tissue study in agriculture, plant breeding, and biotechnology	**02**
		Total=30

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F. Y. B. Sc. Botany [Semester - II]
Course Code - 152-BOT-P
Course Title: Practical Based on BOT 151-BOT-T

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Objectives:

1. To understand the phylogenetic relationships and evolutionary significance of diverse plant groups, fostering an appreciation for plant biodiversity and conservation.
2. To analyse the external and internal morphology of vegetative organs in representative plant groups, such as algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms, enhancing understanding of plant anatomy and physiology.
3. To examine and describe the types and modifications of roots, stems, and leaves, highlighting their structural adaptations and functions in different plant species.
4. To study the morphology of inflorescences, flowers, fruits, and seeds, understanding their role in plant reproduction and development, and identifying key characteristics for plant identification and classification.
5. To explore the variation in floral structures among different plant families, focusing on the arrangement and morphology of floral whorls.
6. To participate in botanical excursions to nearby localities, studying the vegetation and diversity among various plant groups in their natural habitats, fostering fieldwork skills and ecological awareness.

OUTCOMES:

1. Students will be able to identify and classify a wide range of plant species from different habitats, understanding their ecological roles and evolutionary relationships.
2. Students will be able to analyze and interpret the external and internal morphology of vegetative organs in various plant groups, enhancing their knowledge of plant anatomy and physiology.
3. Students will gain practical skills in examining and describing the types and modifications of roots, stems, and leaves, understanding their structural adaptations and ecological functions.
4. Students will acquire the ability to investigate and describe the reproductive structures and life cycles of different plant groups, including algae, fungi, bryophytes, pteridophytes, gymnosperms, and angiosperms.
5. Students will understand the morphology and function of inflorescences, flowers, fruits, and seeds, and will be able to identify key characteristics used in plant identification and classification.
6. Students will gain hands-on experience in botanical fieldwork, including conducting botanical excursions, documenting vegetation, and studying plant diversity in natural habitats.

F. Y. B. Sc. Botany [Semester - II]
Course Code - 152-BOT-P
Course Title: Practical Based on BOT 151-BOT-T
[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Sr. No.	Title of the Practical	No. of Practical
1	Study of economic importance of Algae	1P
2	Study of economic importance of Fungi	1 P
3	Study of economic importance of Lichens	1 P
4	Study of economic importance of Bryophytes	1 P
5	Study of economic importance of pteridophytes	1 P
6	Study of economic importance of Gymnosperms	1 P
7	Study of economic importance of Angiosperms	1 P
8	Study of comparative account of Dicotyledonous and Monocotyledonous plants with suitable examples.	1 P
9	Study of types of inflorescences.	1 P
10	Study of typical flower w.r.t. floral whorls calyx, corolla, perianth, androecium, gynoecium (*Hibiscus*, *Datura*, *Brassica*, *Glyricidia / Clitoria / Bean, Adhatoda / Ocimum*, *Polyanthus, Bouganvelia, Citrus,* Sunflower, *Cucurbita*)	1 P
11	Study of types of fruits.	1 P
12	Study of internal structure of Dicot and Monocot root	1 P
13	Study of internal structure of Dicot and Monocot Stem	1 P
14	Study of internal structure of Dicot and Monocot Leaf	1 P
15	Botanical Excursion to nearby locality to study the vegetation and diversity among various plant groups.	1 P

F.Y. B. Sc. Botany
Semester – II

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)			2 C
	SEC-153-BOT-P	Plant Propagation Techniques	

F. Y. B. Sc. Botany [Semester - II]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SEC-153-BOT-P
Course Title: Plant Propagation Techniques

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

OBJECTIVES:

1. Enable students to identify and demonstrate the use and maintenance of various tools and equipment essential for plant propagation, ensuring a thorough understanding of their applications in horticulture.
2. Introduce students to the concepts and operational details of various plant propagation units. Utilize ICT tools to demonstrate the various climatic controls and their effects on plant growth, preparing students for modern horticultural practices.
3. Equip students with the knowledge to identify and describe various types of ornamental plants enhancing their understanding of botanical diversity and aesthetic applications.
4. Teach students the practical aspects of nursery management which are crucial skills for nursery operation.
5. Provide practical exposure to natural and artificial vegetative propagation methods to understand the biological and environmental factors that influence successful plant propagation.
6. Demonstrate various nursery management practices including different types of irrigation systems, fertilizer applications, and weed control methods. This will enable students to manage nurseries effectively and sustainably.
7. Introduce students to advanced horticultural practices to provide modern approaches and creative solutions in urban horticulture.

OUTCOMES:

1. Students will gain hands-on experience and proficiency in the use and maintenance of various tools and equipment used in plant propagation, enabling effective and efficient handling of nursery operations.
2. Students will be able to operate and manage different types of controlled environments for plant propagation.
3. Students will develop skills in identifying, categorizing, and cultivating differenttypes of ornamental plants for enhancing their ability to design and maintain aesthetic garden spaces.
4. Students will acquire the ability to prepare nursery beds, select appropriate planting materials and containers, and effectively raise seedlings, applying their knowledge to the establishment and management of a successful nursery.
5. Students will master both natural and artificial vegetative propagation methodswith diverse methods to propagate various plant species.
6. Students will demonstrate knowledge and practical skills in different types of irrigation systems, fertilizer applications, and weed control strategies, contributing to sustainable nursery and garden management.
7. Students will learn and apply advanced horticultural practices using modern tools and techniques, showcasing their capability in specialized gardening methods.

F. Y. B. Sc. Botany [Semester - II]

Course Category – Skill Enhancement Course – Practical (SECP)

Course Code – SEC-153-BOT-P

Course Title: Plant Propagation Techniques

[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Sr. No.	Title of the Practical	No. of Practical
1	Demonstration of Tools and Equipment's used for plant propagation	01 P
2	Demonstration of Glass house, Green House, Net House and Poly house using ICT tools	01 P
3	Study of plants in ornamental gardens – Climbers, Creepers, Palms, Ferns, Grasses (Cacti) and Succulents.	01 P
4	Demonstration of planting materials and various types of containers used in nursery.	01 P
5	Preparation of nursery beds for raising of seedlings.	01 P
6	To study the natural vegetative methods of plant propagation.	02 P
7	To study the artificial vegetative methods of plant propagation – cutting and grafting	02 P
8	To study the artificial vegetative methods of plant propagation – budding and layering	02 P
9	To study the potting and repotting of ornamental plant.	01 P
10	Demonstration of different types of irrigation systems, fertilizer applications and weed practices in nursery management.	01 P
11	Demonstration of Bonsai techniques, Terrace, Vertical, and Indoor Gardenwith the help of ICT tools.	01 P
12	Study of soil w.r.t. water holding capacity and pH	01P
13	Visit to crop/Ornamental /Forest nursery and submission of visit report.	01 P

F.Y. B. Sc. Botany
Semester – II

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Ability Enhancement Courses (AEC) – (1T = 2 C)	AEC-151-ENG-T	English	**2 C**
Value Education Courses (VEC) – (1T = 2 C)	VEC-151-ENV-T	Environmental Awareness	**2 C**
Co-curricular Courses (CC) – (1T = 2 C)	CC-151-T	Any one from basket	**2 C**