Savitribai Phule Pune University, Pune

(Formerly, University of Pune)

Under Graduate 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)

(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

To be implemented from

Academic Year 2024-2025

Framed by

BOARD OF STUDIES IN BOTANY

Savitribai Phule Pune University,

Ganeshkhind, Pune -07.

(Dr. Mahesh N. Khande)
Chairman - BoS Botany

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 Under Graduate degree in Botany (F.Y.B.Sc. Botany) program at Savitribai Phule Pune University, 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 Under Graduate (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 also 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 Honours in Botany (04 years)

Syllabus revised as per National Education Policy (NEP) 2020 for the Colleges Affiliated to Savitribai Phule Pune University, Pune

2. Faculty - Science and Technology

3. To be implemented -For F.Y.B.Sc. (Semester I and Semester II), from August 2024.

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 unfavourable 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. In light of 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 goals and 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.

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 student should opt 22 credits per semester. This clause aims to give student 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 Under Graduate 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 given as 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 Savitribai Phule Pune University, 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) + University Theory Exam (35 M) = Total 50 M
  - Duration: For Internal exam = 40 Min. and For University Exam = 02 hours.
- **Practical Paper of 2 Credits -**
  - Internal Exam (15 M) + University Practical Exam (35 M) = Total 50 M
  - Duration: For Internal exam = 40 Min. and For University 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 SPPU, Pune.

13. ATKT Rules: As per the norms given by SPPU, 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 the part of 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 have 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 the question paper of 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-T	Applied Aspects of Plant Sciences	**2 C**
	BOT-102-P	Practical Based on BOT-101-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**
Generic Elective (GE) / Open Elective (OE) - (1T = 2 C) (Any one from basket)	OE-101-BOT-T	Agro-tourism	**2 C**
	OE-102-BOT-T	Plants and Human Welfare	
	OE-103-BOT-T	Agriculture for Competitive Exams	
Skill Enhancement Courses (SEC) – (1T / 1P = 2 C) (Any one from basket)	SEC-101-BOT-P	Flower Design Techniques	**2 C**
	SEC-102-BOT-P	Post-Harvest Technology	
	SEC-103-BOT-P	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-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**
Generic Elective (GE) / Open Elective (OE) – (1P = 2 C) (Any one from basket)	OE-151-BOT-P	Fruit Processing and Flower Arrangement	**2 C**
	OE-152-BOT-P	Mushroom technology	
	OE-153-BOT-P	Vertical and Terrace Gardening	
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)	SEC-151-BOT-P	Plant Preservation Techniques	**2 C**
	SEC-152-BOT-P	Millets for Sustainable Agriculture Development	
	SEC-153-BOT-P	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-T	Applied Aspects of Plant Sciences	**2 C**
	BOT-102-P	Practical Based on BOT-101-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 - I]

Course Code - BOT-101-T

Course Title: Applied Aspects of Plant Sciences

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Applied Plant Sciences** 1.1. Overview of key concepts and principles 1.2. Importance of applied plant sciences in addressing global challenges.	**02**
2	**Plant Biotechnology** 2.1. Genetic engineering techniques in crop improvement. 2.2. Plant Tissue Culture for improvement of crop productivity. 2.3. Biopharmaceuticals and plant-derived drugs. 2.4. Applications of biotechnology in plant breeding and biotic/abiotic stress tolerance.	**04**
3	**Precision Agriculture** 3.1. Remote sensing and GIS applications in agriculture. 3.2. Use of drones and sensors for crop monitoring and management.	**03**
4	**Sustainable Agriculture Practices** 4.1. Organic farming methods and principles. 4.2. Integrated pest management strategies.	**03**
5	**Plant-Microbe Interactions** 5.1. Role of plant-associated microbes in plant health and productivity. 5.2. Applications of beneficial microbes in agriculture.	**03**
	Credit II	**15**
6	**Climate Change and Plant Sciences** 6.1. Impact of climate change on plant growth and agriculture. 6.2. Strategies for mitigating climate change effects through plant science interventions.	**03**
7	**Urban Agriculture and Vertical Farming** 7.1. Challenges and opportunities in urban agriculture. 7.2. Vertical farming technologies and their applications. 7.3. Ornamental plant cultivation. 7.4. Urban gardening and landscaping.	**03**
8	**Plant Health and Disease Management** 8.1. Diagnosis and management of plant diseases. 8.2. Emerging technologies for disease detection and control.	**03**
9	**Postharvest Technology** 4.1. Techniques for prolonging shelf life and maintaining quality of harvested produce. 4.2. Importance of postharvest management in reducing food loss and waste.	**03**
10	**Environmental applications** 10.1. Plant ecology and conservation 10.2. Ecological restoration techniques 10.3. Phytoremediation and air purification.	**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. "Plant Pathology" by George N. Agrios.
4. "Soil Science: Principles and Practices" by R.K. Mehra.
5. "Principles of Plant Biotechnology" by P.K. Gupta.
6. "Principles of Weed Science" by S.S. Hundal.
7. "Introduction to Horticulture" by Kumar and Singh.
8. "Plant Physiology" by Pandey and Sinha.
9. "Principles of Plant Pathology" by S.N. Agarwal.
10. "Principles of Agronomy" by S.R. Reddy and G.H. Sankara Reddy.
11. "Plant Breeding: Principles, Methods and Applications" by B.D. Singh.
12. "Postharvest: An Introduction to the Physiology and Handling of Fruit, Vegetables and Ornamentals" by R. Wills, B. McGlasson, D. Graham, and D. Joyce
13. "Plant Nutrition and Soil Fertility Manual" by J. Benton Jones Jr.
14. "Sustainable Agriculture" edited by Eric Lichtfouse
15. "Crop Production: Evolution, History, and Technology" by C. Wayne Smith and Julian R. Smith.
16. "Plant Physiology and Development" by Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy.
17. "Plant Biotechnology and Agriculture: Prospects for the 21st Century" edited by Arie Altman and Paul Michael Hasegawa.
18. "Principles of Plant Genetics and Breeding" by George Acquaah.
19. "Remote Sensing Applications in Agriculture: Opportunities and Constraints" edited by B.S. Bhattacharya and S.K. Ghosh.
20. "Precision Agriculture: Technology and Economic Perspectives" edited by P. Sengupta and S. Shankar.
21. "Precision Farming in Horticulture: Approaches and Applications" edited by Debashis Mandal, V.K. Gupta, and R.N. Pal.
22. "Smart Technologies for Sustainable Smallholder Agriculture: Upscaling in Developing Countries" edited by Justice O. Alabi and Harjit Kaur.
23. "Precision Agriculture: Principles and Applications" edited by Manjit Singh and Rajan Bhatia.
24. "Climate Change and Agriculture: Adaptation Strategies and Mitigation Options" edited by Mannava V.K. Sivakumar, Raju Goyal, and Ashwani Kumar.
25. "Climate Change and Plant Biodiversity" edited by Dinesh Kumar and Anil K. Singh.
26. "Climate Change and Agricultural Ecosystems" edited by Mannava V.K. Sivakumar and James Hansen.
27. "Plant Responses to Climate Change: From Molecular to Ecosystems Perspective" edited by Chittaranjan Kole.
28. "Climate Change and Plant Abiotic Stress Tolerance" edited by Narendra Tuteja, Sarvajeet Singh Gill, Antonio F. Tiburcio, and Renu Tuteja.
29. "Urban Agriculture: Policy, Law, Strategy, and Implementation" by Mark Roseland and Wayne J. Caldwell.
30. "Vertical Farming: Concepts, Applications, and Challenges" edited by Kotikalapudi Sriram and Anuj Bhatia.
31. "Rooftop Urban Agriculture" by Francesco Orsini, Marielle Dubbeling, and Henk de Zeeuw.
32. "Urban Agriculture: A Global Perspective of the Role of Cities in Food Systems" edited by René van Veenhuizen.
33. "Vertical Farming: Sustainable Indoor Agricultural Systems" edited by Toyoki Kozai, Genhua Niu, and Michiko Takagaki.

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

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

Sr. No.	Title of the Practical	No. of Practical
1	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
2	Demonstration of genetically modified crops – Bt –Cotton, Bt-Maize, Golden Rice, Round-up ready Soybean.	1 P
3	Estimation of soil organic carbon by using Walkley-Black or Similar method (Wet oxidation).	1 P
4	To study the degradation of toxic textile dyes using plant biomass and its characterization using UV-Spectrophotometer and/or FTIR.	1 P
5	Study of petiole analysis of stressed and unstressed plants.	1 P
6	To demonstrate the composting of kitchen waste for the preparation of biofertilizer.	1 P
7	Demonstration of *Azolla* cultivation, nutrition and production attributes and its application as biofertilizer.	1 P
8	Preparation of 'Sanjivani Amrut' and its application to the crop and garden plants.	1 P
9	To study the effect of Mycorrhiza on growth attributes of crop plants.	1 P
10	Study on preparation of Dashparni Ark and EM solution.	1 P
11	Study of various plant-associated microbes useful in improvement of plant health and productivity – Rhizobia – *Rhizobium;* Mycorrhizal Fungi - arbuscular mycorrhizal fungi (AMF) such as *Glomus* spp., and ectomycorrhizal fungi (ECM) like *Laccaria* spp. and *Pisolithus* spp.; Plant Growth-Promoting Rhizobacteria (PGPR) - *Pseudomonas, Bacillus*, and *Azospirillum* spp.; Endhophytic fungi - *Trichoderma* and *Claviceps* spp.; Nitrogen-Fixing Cyanobacteria: *Nostoc*.	1 P
12	To demonstrate the Post-Harvest techniques w.r.t. preparation of amla candy and alepak (Zinger wadi), aloe-vera gel.	1 P
13	To study the vertical farming structures for its application in urban agriculture or vertical gardening.	1 P
14	Demonstration of Hydroponics and aeroponics.	1 P
15	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
16	Visit to the plant based industry for exploring the products and byproducts of the industry and its importance in the economics.	1 P
17	Case study on ecological restoration of the any environmental site available in nearby locality.	1 P

Note: Conduct any 15 practical's from the above mentioned list.

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Generic Elective (GE) / Open Elective (OE) - (1T = 2C) (Any one from basket)	OE-101-BOT-T	Agro-tourism	**2 C**
	OE-102-BOT-T	Plants and Human Welfare	
	OE-103-BOT-T	Agriculture for Competitive Exams	

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

Course Category – Open Elective / Generic Elective (OE)

Course Code – OE-101-BOT-T

Course Title: Agro-Tourism

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Agro-tourism** 1.1. Definition, nature and scope of agro-tourism. 1.2. Historical background and evolution of Agro-Tourism 1.3. Needs and opportunities of agro-tourism. 1.4. Importance of agro-tourism in rural development.	**03**
2	**Types of Agro-Tourism Activities** 2.1. Types of agro-tourism activities – Farm tours and visits; farm stays and rural accommodations; agricultural festivals and events. 2.2. Concept of food and agriculture tourism.	**03**
3	**Important Factors related to Agro-Tourism** 3.1. Location for agro-tourism center. 3.2. Geographical factors- relief, climate, drainage pattern, soil. 3.3. Socio-economic factors- Capital, transportation facilities, market, landholding of farmers, tradition, cropping pattern.	**05**
4	**Concerns of Agro-Tourism Centers** 4.1. Criteria to start Agro-Tourism centers - Infrastructure Facilities, livestock, Recreation facilities, Other Miscellaneous. 4.2. Benefits of Agro-Tourism Centers. 4.3. Challenges of the Agro-Tourism centers.	**04**
	Credit II	**15**
5	**Activities in Agro-Tourism centers** 5.1. Animal Feeding, Guided field visits and tour, Watching domestic animals, seasonal crop festival. 5.2. Rural Festival/Jatra, Marketing of Farmer's produce (local /organic products), Milking the Cow and Buffalos, Religious Temple visits. 5.3. Swimming at well, ponds or river, fishing, Local site seeing. 5.4. Rural/folk games, dance, music etc. - Bullock cart, Bicycle, Tractor rides. *Vittidandu, Surparambhya, Kabaddi, Langadi, Kho-Kho, Bullock ploughing, Lagore & Gallori*. 5.5. Adventure activities- mountaineering, trekking, river crossing, cycling etc.	**05**
6	**Agro-Tourism policies** 6.1. Agro-Tourism policies in Maharashtra state. 6.2. Maharashtra Krishi Paryatan Vistar Yojana- MKPVY 6.3. Introduction and the concept. 6.4. Guidelines for approval and Guidelines of agro- tourism. 6.5. Application form for registration. 6.6. Checklist of facilities for approval. 6.7. Declaration by the farmer. 6.8. Undertaking by the farmer.	**07**

	6.9. Performa for police verification.	
7	**Tourism Marketing strategy** 7.1. Use of Social Media, Print Media, Attractive booking policies (for group/company/corporate etc.) 7.2. Website/Apps development for online booking and marketing.	**03**

References:

1. Dennis M. Brown and Richard J. Reeder, 'Agri-tourism Offers Opportunities for FarmOperators'2004, U.S.A.
2. Dev, Mahendra S. (1996), Agricultural Policy Framework for Maharashtra: Issues and Options, Proceeding/Project Report No. 21, July 1996, Indira Gandhi Institute of Development Research, Mumbai.
3. Taware Pandurang, Director – Marketing A.T.D.C., Pune, Agri – Tourism: Innovative

Supplementary Income Generating Activity For Enterprising Farmers.

4. Maharashtra Krishi Paryatan Vistar Yojana 2008, A.T.D.C., Pune.
5. Lucey T, *Management information system*: New Delhi: BPB Publication.
6. Obrien James, A, *Management Information Systems: managing information technology in the e-business enterprise*, New Delhi: Tata McGraw- Hill Publication Company.
7. Michael l. Kasavana, John J. Cahill, *Managing Computers in the Hospitality Industry*, EI-AH&LA, USA.
8. Saxena S and Prabhpreet Chopra, *Computer Applications in Management,* Vikas Publishing House Pvt. Ltd. New Delhi.
9. Dimitrios Buhalis; e Tourism: information technology for strategic tourism management, Financial Times Prentice Hall, 2003.
10. Pauline J. Sheldon; Tourism Information Technology**,** CAB International, 2002.
11. Steven Otfinoski; **Computers;** Marshall Cavendish, 2007.
12. www.agritourism.in
13. www.ncagr.com

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

Course Category – Open Elective (OE) / Generic Elective (GE)

Course Code – OE-102-BOT-T

Course Title: Plants and Human Welfare

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction** 1.1. Origin of Cultivated Plants- Concept of Centers of Origin. 1.2. Domestication of plants and origin of agriculture. 1.3. Major and Minor food yielding Crops – Cereals, Pulses, Oil Seeds, Vegetables and Fibers.	**04**
2	**Cereals and Pulses** 2.1. Introduction and definition. 2.2. Cereals and Millets - Uses and byproducts of Wheat, Rice, Maize, Jowar, Bajara and Nachani. 2.3. Non-cereals - Uses and byproducts of Potato, Tapioca and Arrowroot. 2.4. Pulses - Uses and byproducts of Bengal gram, Pigeon Pea, Moong bean, Udid, Soybean, etc. 2.5. Importance of cereals, millets and pulses in human diet.	**06**
3	**Oils and Fats** 3.1. Introduction 3.2. Uses of edible oil yielding plants - Groundnut, Safflower, Mustard, Sesame, Coconut, Sunflower, Soybean, Rice-bran. 3.3. Traditional Methods of oil extraction and its health benefits 3.4. Non edible oil yielding plants- Neem oil, Karanj oil, Castor oil	**05**
	Credit II	**15**
3	**Vegetables and Fruits** 3.1. Introduction 3.2. Vegetables - Classification (as per parts used), Uses, processed byproducts of vegetables. 3.3. Fruits - Uses, processed byproducts of fruits – Mango, Grapes, Banana, Cashew Nut, Custard apple, Papaya, Guava, Lemon, Orange, etc. 3.4. Scope and importance of processed vegetables and fruits.	**05**
4	**Spices and Condiments** 4.1. Introduction, difference between spices and condiments 4.2. Importance of spices and condiments in diet - Turmeric, Ginger, Red Chilli, Coriander, Curry leaves, Clove, Saffron, Cardamom, Nutmeg, Cinnamon, Black pepper, Mustard, etc.	**05**
5	**Beverages** 5.1. Definition, types (alcoholic and non-alcoholic) 5.2. Processing of beverages – Wine production (Banana and Grapes), Tea Production and coffee production	**05**

References:

1. A Text Book of Economic Botany A.V.S. Samba Murty, N.S. Subrahmanyam.
2. Economic Botany in the Tropics - S.L. Kochhar.
3. Economic Botany - Albert F. Hill.
4. Economic Botany B.P. Pandey. -
5. Economic Botany - S. Sen.
6. Economic Botany - Ashok Bende, Ashok Kumar.
7. A Text Book of Economic Botany - V. Verma.
8. A Text Book of Botany Volume III - S.N. Pandey, A. Chaddha.
9. Botany of Field Crops D. Daniel Sundararaj, G. Tulsidas. -
10. Text Book of Biochemistry E.S. West, W.R. Todd, - H.S. Mason, J.T.V. Bruggin.
11. Introductory Taxonomy B.S. Trivedi, B.B. Sharma. -
12. Glossary of Indian Medicinal Plants - R.N. Chopra, S.L. Nayar, I.C. Chopra.
13. Indian Medicinal Plants - A.V. Sale.
14. Compendium of Indian Medicinal Plants - Volume I, Ram P. Rastogi, B.N. Mehrotra.
15. Economic Botany - Beryl Brintnall Simpson, Molly Conner - Ogorzaly.
16. Plant Groups - H. Mukherji.
17. A Text Book of Botany Volume I-S.N.Pandey, P.S. Trivedi.
18. A Text Book of Botany Volume II S.N. Pandey, P.S. Trivedi, S.P. Misra.
19. A Text Book of Botany Volume 1- A.K. Saxena, R.P. Sarabhai.
20. Botany for Degree Students - Fungi - B.R. Vashishta.
21. Botany for Degree Students - Bryophyta - B.R. Vashishta.
22. College Botany Volume 1-S. Sundara Rajan.
23. College Botany Volume II - S. Sundra Rajan.
24. Britanica Macropaedia Volume – 19.
25. Preservation of Fruits and Vegetables (1986) - Girdhari Lal, G.S. Sidappa, G.L. Tandon.
26. Albert F. Hill and O. P. Sharma (1996), Hill's Economic Botany, Tata Mc-Graw-Hill Publishing Company Limited, New Delhi.
27. Samba Murty A.V.S.S. and Subrahmanyam N.S. (1989). A textbook of Economic Botany, Wiley Eastern Limited, New Delhi.
28. Verma V. (1982). A textbook of Economic Botany, Emkay Publications, New Delhi.
29. Pandey B.P. (1990), Economic Botany, S. Chand and Company Ltd., New Delhi.
30. Singh B. D. (1983), Plant breeding, Kalyani Publishers, Ludhiana.
31. Chaudhary R. C. (1988), Introduction to Plant breeding, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
32. Beryl Brintnall Simpson and Molly Conner -Ogorzaly (1986) Economic botany (plants in our world) Mc Graw Hill Book Company.
33. Shreemali J.L. (1979): Economic botany. Kitab Mahal Allahabad.
34. Achaya K.T. (1990) oil seeds and oil milling in India - a cultural and historical survey. Oxford & IBH Publishing C. Pvt. Ltd. New Delhi.
35. Vaida V.G. Sahasrabuddehe KR. and V.S. Khuspe (1993) Crop production and field experimentation. Continental Prkashan, Pune-30.

F. Y. B. Sc. Botany [Semester - I]
Course Category – Open Elective (OE) / Generic Elective (GE)
Course Code – OE-103-BOT-T
Course Title: Agriculture for Competitive Exam

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

Sr. No.	Topic Details	No. of Lectures
	Credit I - Basics of Agriculture	**15**
1	1.1. Definition, meaning and branches of Agriculture. 1.2. Factors affecting crop production. 1.3. Cropping Systems: Definition and types of cropping systems. 1.4. Meteorology: weather parameters.	**02**
2	2.1. Sources of water. 2.2. Absorption and movement of water in soil. 2.3. Soil moisture constants. 2.4. Forms of soil water. 2.5. Factors affecting available soil moisture. 2.6. Absorption of soil moisture by plant.	**03**
3	3.1. Water requirement. 3.2. Irrigation requirement of crops. 3.3. Factors affecting water requirement. 3.4. Measurement of irrigation. 3.5. Water use efficiency. 3.6. Importance of drainage and their types. 3.7. Effect of drainage on soil and crop growth.	**03**
4	4.1. Food production and consumption trends in India. 4.2. Food security and growing population. 4.3. NFSM and other food security related Government Initiatives. 4.4. Availability of food grains, per capita expenditure on food. 4.5. Food based dietary approaches to eliminate hunger. 4.6. Protein Energy Malnutrition or Protein Calorie Malnutrition (PEM or PCM). 4.7. HRD in context of work capacity of women and children.	**05**
5	5.1. Geo-informatics. 5.2. Crop discrimination and Yield monitoring. 5.3. Remote sensing concepts and application in agriculture. 5.4. Global positioning system (GPS).	**02**
	Credit II - Act and Laws related to Agriculture	**15**
6	**Maharashtra land revenue code** 6.1. Classification of land occupancies. 6.2. Responsibilities and duties of revenue officer. 6.3. Use of lands for agriculture and non- agriculture. 6.4. Encroachment of land, Revenue surveys. 6.5. Assessment and settlement of land revenue.	**04**
7	**Tenancy and agricultural lands act** 7.1. Concept of tenancy. 7.2. Right of tenancy.	**03**

	7.3. Condition of purchase of agriculture land in Maharashtra. 7.4. Sale of tenanted land. 7.5. Confiscation of powers of revenue officers.	
8	**Land acquisition acts** 8.1. Essential commodities act in relation to cotton, sugarcane, food grains. 8.2. Right to Fair compensation and Transparency in Land Acquisition. 8.3. Rehabilitation and Resettlement Act, 2013.	**02**
9	**Scopes, benefits coverage and limitations of the amendments** 9.1. Agriculture Pest and Disease Act (1950) 9.2. Prevention of Food Adulteration Act (1954) 9.3. Food production order Act (1956) 9.4. Asian Development Bank Act (1966) 9.5. Indian Seeds Act (1966) 9.6. Vegetable Oil Product Act (1967) 9.7. Insecticides Act (1968) 9.8. Agriculture Produce Market Act (1972) 9.9. Meat Food Products Order (1973) 9.10. Vegetable Oil Product (standard of quality) Order (1975) 9.11. Regional Rural Banks Act (1976) 9.12. Indian Veterinary Council Act (1984) 9.13. Consumer Protection Act (2019) 9.14. Indian Fisheries Act (1897) 9.15. Central Agricultural Universities Act (1992) 9.16. Destructive insects and Pests (Amendment and Validation) Act (1992) 9.17. The Protection of Plant Varieties and Farmers' Rights Act (2001) 9.18. Biodiversity Act (2002).	**06**

References:

1. Textbook of Field Crops Production-Food grain Crops (Vol-I), ICAR Publication, New Delhi.
2. Textbook of Field Crops Production-Commercial Crops (Vol-II), ICAR Publication, New Delhi.
3. Handbook of Agriculture, ICAR Publication, New Delhi.
4. Rana, K.S., Choudhary, A.K., Sepat, S. and Bana, R.S. 2014. Advances in Field Crop Production. IARI, New Delhi. pp 475.
5. Choudhary, A.K., Rana, D.S., Bana, R.S., Pooniya, V., Dass, A., Kaur, R., Rana, K.S. 2015. Agronomy of Oilseed and Pulse Crops, IARI, New Delhi & ICAR, DARE, New Delhi, India. pp 206.
6. Bal, J.S. (2007). Fruit growing. Kalyani Publishers, Ludhiana, India.
7. Bose, T.K. and Som, M.G. (1995) Vegetables crops of India. Naya Prokash Publications, Kolkatta, India.
8. Chadha, K.L. (1993). Handbook of horticulture, ICAR, India.
9. Chadha, T.R. (2000). Textbook of temperate fruits. ICAR, New Delhi.
10. Chattopadhyay, T.K. A textbook on Pomology, Vol. 2,3,4, Kalyani publishers, Ludhiana, India.,
11. Mukhopadhyay, A and Randhawa, G.S. (1992). Floriculture in India, Allied Publishers, New Delhi.

12. Panda, H. (2010). Handbook on Spices and Condiments (Cultivation, Processing and Extraction). Asia Pacific Business Press Inc., New Delhi.

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)	SEC-101-BOT-P	Flower Design Techniques	**2 C**
	SEC-102-BOT-P	Post-Harvest Technology	
	SEC-103-BOT-P	Algal Technology	

F. Y. B. Sc. Botany [Semester - I]
Course Category – Skill Enhancement Course (SEC)
Course Code – SEC-101-BOT-P
Course Title: Flower Design Techniques

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

Sr. No.	Topic Details	Weightage
1	To study the structure of typical flower.	**1P**
2	To study the seasonal flowers and their characteristics.	**1P**
3	To study the types/styles of flower arrangements (e.g., Ikebana, European, Contemporary) with the help of ICT tools.	**1P**
4	To demonstrate the essential tools and materials used in flower arrangement.	**1P**
5	To study the selection of flowers and foliage types used for flower arrangement.	**2P**
6	Demonstration of drying and preservation of flowers.	**1P**
7	Preparation of traditional flower designs - garland, Gajra, Veni etc.	**1P**
8	Preparation of floral Rangoli.	**1P**
9	To study the different type of bouquets.	**2P**
10	To study the methods of vase life improvement of cut flowers.	**1P**
11	Visit to floriculture industry and study of floral business economics.	**2P**
12	To study the role of flower arrangement in event management.	**1P**

F. Y. B. Sc. Botany [Semester - I]
Course Category – Skill Enhancement Course (SEC)
Course Code – SEC-102-BOT-P
Course Title: Post-Harvest Technology

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

Sr. No.	Topic Details	Weightage
1	To demonstrate the methods of post-harvest handling - Harvesting, Precooling, Sorting, Grading, Packaging with the help of ICT Tools	1 P
2	To demonstrate the methods of Sorting and Grading	1 P
3	To study the preparation of Jam, Jellies and Candies.	3 P
4	To demonstrate the equipment's and technology used in Food Processing with the help of ICT tools	1 P
5	To study the preparation of Tomato sauce, puree and ketch up	2 P
6	To study the preparation of crush, squash and syrup	3 P
7	To study the preparation of pickles from fruits /vegetables	1 P
8	To study the preparation of Aloe vera gel	1 P
9	Visit to fruit processing industry/ cold storage/ fruits ripening unit	2 P

F. Y. B. Sc. Botany [Semester - I]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SEC-103-BOT-P
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 fresh water 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 fresh water 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 waste water 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]**

Sr. No.	Topic Details	No. of Lectures
	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.	**01**
2	**Algae** 2.1. Introduction, definition and characters of Algae, suitable examples. 2.2. Economic and Biotechnological Importance of Algae – 2.2.1. Algae as food: nutritional value and culinary uses. 2.2.2. Algae in industry: biofuels, pharmaceuticals, and bioremediation. 2.2.3 Biotechnological applications: algae cultivation, genetic engineering, and algae-based products. 2.2.4. Future prospects and challenges in algae research and utilization.	**02**
3	**Fungi** 3.1. Introduction, definition and general characters of fungi; suitable examples. 3.2. 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. Pathogenic fungi and their impact on plants, animals and humans. 3.2.4. Economic importance of fungi in industry and agriculture. 3.2.5. Fungi in food production and fermentation processes.	**02**
4	**Lichen** 4.1. Introduction; definition and general characters of lichen; Types– crustose, foliose and fruticose. 4.2. Importance of Lichen – 4.2.1. Ecological significance: contribution to nutrient cycling, soil formation, and erosion control; Role of lichens as bio-indicators of environmental health. 4.2.2. Cultural significance: use in traditional medicine, dyeing, and food for some cultures 4.2.3. Economic significance: use in pharmaceuticals, cosmetics, and environmental monitoring.	**02**
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** 6.1. Introduction; definition and general characters; suitable examples. 6.2. Ecological and Economic Importance of Pteridophytes – 6.2.1. 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. 6.2.2. Economic Importance of Pteridophytes – Ornamental uses: landscaping and indoor plants; Medicinal uses: traditional and modern applications.	**02**
7	**Gymnosperms** 7.1. Introduction; definition and general characters of gymnosperms; suitable examples. 7.2. Ecological and Economic Importance – 7.2.1. Ecological roles of gymnosperms in various ecosystems; adaptations to environment. 7.2.2. Economic significance: timber, paper, resin, ornamental and medicinal uses, etc.	**02**
8	**Angiosperms** 8.1. Introduction; definition and general characters of angiosperms; suitable examples. 8.2. Ecological and Economic importance of Angiosperms: – 8.2.1. Ecological Importance of Angiosperms: Role as Primary producers, in habitat and biodiversity, soil conservation, water regulation; pollinator support. 8.2.2. Economic Importance of Angiosperms: Food, Fodder, Fiber, Medicine, Timber, Ornamental, Horticulture and Landscaping, Biofuel production, Ecosystem services (carbon sequestration, oxygen production, soil stabilization, and water filtration), etc.	**02**
	Credit II – PLANT MORPHOLOGY	**15**
9	**Introduction to Plant Morphology** 9.1. Introduction, Definition; Types of morphology – Descriptive and Interpretative. 9.2. Importance of Morphology.	**01**
10	**Root Morphology** 10.1. Definition, Parts / regions of root; Types – Tap root and fibrous / adventitious root. 10.2. Modifications of roots – Aerial roots (Hanging roots) with velamen tissue in Epiphytes; Haustorial (sucking) roots in Parasites - *Cuscuta*,	**02**

	Respiratory roots / Pnuematophores in Mangrove; Fleshy / Storage roots - Conical, Fusiform, Napiform, and Tuberous roots; Roots modified for Mechanical supports – Stilt, Prop, Climbing, and Clinging roots with examples. 10.3. Functions of roots.	
11	**Stem Morphology** 11.1. Definition, Parts of stem – nodes, internodes, buds, types of buds (Apical, Axillary, Accessory Adventitious and Floral). 11.2. Types of stem – a) Erect – Strong, Weak (Creepers, Trailers and Climbers); b) Prostrate – Procumbent, Decumbent and Diffuse; Modifications of stem – a) Aerial – Phylloclade, Bulbil b) Sub-aerial – Runner, Sucker, Stolon, Offset; c) Underground – Rhizome, Corm, Tuber, Bulb (Tunicated and Scaly). 11.3. Functions of stem.	**02**
12	**Leaf Morphology** 12.1. Definition, Parts of leaf; Stipule, Petiole, Leaf margins, Apices and Base, Surface, Venation, Phyllotaxy, Leaf duration (Caducous, Deciduous, Persistent- Evergreen). 12.2. Types of leaves – Simple and Compound – Pinnately (Unipinnate – Paripinnate and Imparripinnate; Bipinnate, Tripinnate and Decompound) and Palmately (Uni-, Bi-, Tri-, Quadri- and Multifoliate); Leaf Modifications: Tendrils, Spines, Phyllode, Scaly, Reproductive, Trap leaves. 12.3. Functions of leaves.	**02**
13	**Morphology of Inflorescence** 13.1. Definition, Parts of Inflorescence. 13.2. Types of Inflorescence – a) Racemose – i) Main Axis Elongated – Raceme, Spike, Catkin, Spadix; ii) Main Axis Shortened – Umbel and Corymb; iii) Main Axis Flattened – Capitate, Head / Capitulum; b) Cymose – Solitary, axillary, Terminal, Uniparous (Monochasial) – Helicoid and Scorpoid, Biparous (Dichasial), Multiparous (Polychasial) Cyme; c) Special Type – Verticilliaster, Cyathium, Hypanthodium.	**02**
14	**Morphology of Flower** 14.1. Definition, typical structure of flower. 14.2. Types of flowers based on Symmetry, Insertion of floral whorls on thalamus. 14.3. Floral whorls – I) Accessory whorls: a) Calyx: member - sepals, number, cohesion, types of calyx; Modifications of calyx – Petaloid, Pappus, Spurred; b) Corolla: member – petals: Claw and Limb; number, cohesion, types / forms of corolla – Polypetalous Regular – Cruciform, Caryophyllous, Rosaceous; Polypetalous irregular – Papillionaceous; Gamopetalous Regular – Tubular, Infundibuliform, Campanulate, Salvar shaped, Rotate; Gamopetalous Irregular – Bilabiate, Personate and Ligulate;	**05**

	c) Perianth: member – tepals, number, cohesion, modifications – sepaloid and petaloid tepals. Aestivation – Definition; aestivation in calyx, corolla and perianth; types of aestivation. 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 – Marginal, Parietal, Axile, Free-central, Basal, superficial.	
15	**Morphology of Fruit and Seed** 15.1. Fruit: Definition and parts of fruit. 15.2. Seed: Definition, Parts of typical seed.	**01**

References:

1. Ainswarth, Sussman and Sparrow (1973). The Fungi. Vol. IV-A and IV-B. Academic Press.
2. Bendre, Ashok and Kumar, Ashok (1993). A Text Book of Practical Botany, Rastogy Publications, Meerut.
3. Bilgrami, K.S. and Saha, L.C. (1992) A Textbook of Algae. CBS Publishers and Distributors, Delhi.
4. Chamberlain, C.J. (1934). Gymnosperms- Structure and Evolution. Chicago.
5. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms. Chicago.
6. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperms taxonomy. Oliver and Boyd Publ. London.
7. Dube, H.C. (1990). An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
8. Dutta, S.C. (1988). Systematic Botany. Wiley Eastern Ltd., New Delhi.
9. Eames, E.J. (1983). Morphology of Vascular Plants. Standard University Press.
10. Gangulee and Kar (2006). College Botany. New Central Book Agency (P.) Ltd. Kolkata.
11. Gangulee, Das and Dutta (2002). College Botany. Vol. I, New Central Book Agency (P) Ltd.
12. Krishnamurty, V. (2000). Algae of India and neighboring countries, Chlorophyta, Oxford and IBH, New Delhi.
13. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
14. Parihar, N.S. (1976). Biology and Morphology of Pteridophytes. Central Book Depot.
15. Parihar, N.S. (1980). Bryophyta, An Introduction of Embryophyta. Vol. I. Central Book Distributors, Allahabad.
16. Puri, P. (1980). Bryophyta: Broad prospective. Atma Ram & Sons, Delhi.
17. Rashid, A. (1999). An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
18. Sharma, O.P. (1990). Text Book of Pteridophyta. McMillan India Ltd. Delhi.
19. Singh, V. and Jain, D.K. (2010). Taxonomy of Angiosperms. Rastogy Publications, Meerut.
20. Singh, V., Pande, P.C., and Jain, D.K. (2011). A Text Book of Botany: Angiosperms. Rastogy Publications, Meerut.

21. Smith, G.M. (1955). Cryptogamic Botany Vol. II. McGraw Hill.
22. Smith, G.M. (1971). Cryptogamic Botany. Vol. I: Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
23. Smith, G.M. (1971). Cryptogamic Botany. Vol. II: Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
24. Sporne, K.R. (1986). The Morphology of Pteridophytes. Hutchinson University Library, London.
25. Sundar Rajan, S. (1999). Introduction to Pteridophyta. New Age International Publishers, New Delhi.
26. Vashishta, P.C., Sinha, A.R. and Kumar, Anil (2006). Gymnosperms. S. Chand and Comp. Ltd. New Delhi.
27. Vashista, B.R., Sinha A.K. and Kumar, A. (2008). Botany for degree students- Pteridophyta, S. Chand and Comp. Ltd. New Delhi.
28. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Algae, S. Chand Publication.
29. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Fungi, S. Chand Publication.
30. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree Students- Bryophytes, S. Chand Publication.
31. Plant Systematics by Michael G. Simpson, Elsevier, Academic Press.
32. Plant Systematics – An Integrated approach. Third edition, by Gurucharan Singh, Science Publishers.

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 life cycle of *Spirogyra* w.r.t. thallus, cell structure and reproduction.	1 P
2	Study of life cycle of *Albugo* w.r.t. host, occurrence, morphology and reproduction.	1 P
3	Study of forms of lichens on the basis of their external morphology – Crustose, Foliose and Fruticose.	1 P
4	Study of life cycle of *Riccia* w.r.t. external and internal morphology of thallus and reproduction.	1 P
5	Study of *Nephrolepis* w.r.t. external morphology of sporophyte; Internal morphology of rachis and leaflet/ pinna passing through sori.	1 P
6	Study of *Cycas* w.r.t. external morphology of sporophyte; Internal morphology of leaflet / pinna; Reproduction – male and female cone.	1 P
7	Study of comparative account of Dicotyledonous and Monocotyledonous plants with suitable examples.	1 P
8	Study of root w.r.t. its types and modifications.	1 P
9	Study of stem w.r.t. its types and modifications.	2 P
10	Study of leaf w.r.t. its types and modifications.	1 P
11	Study of types of inflorescence.	1 P
12	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
13	Study of types of fruits.	1 P
14	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
Generic Elective (GE) / Open Elective (OE) – (1P = 2 C) (Any one from basket)	OE-151-BOT-P	Fruit Processing and Flower Arrangement	**2 C**
	OE-152-BOT-P	Mushroom technology	
	OE-153-BOT-P	Vertical and Terrace Gardening	

F.Y.B.Sc. Botany [Semester-II]
Course Category – Generic Elective / Open Elective (OE)
Course Code – OE-151-BOT-P
Course Title: Fruit Processing and Flower Arrangement

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

Sr. No.	Practical	No. of Practical
1	Identification of equipment and machinery used in preservation of fruits & vegetables	1 P
2	To study preservation by drying and dehydration	1 P
3	Preparation of Squash	1 P
4	Preparation of Jam	1 P
5	Preparation of Jelly	1 P
6	Preparation of Candy and preserve	1 P
7	Preparation of Ketchup	1 P
8	Study of tools used in flower arrangements.	1 P
9	Study of different types of architecture in the flower arrangements.	1 P
10	Preparation of different types of decorative flower based arrangements	1 P
11	Study of vase life of flower	1 P
12	Preparation of basic tied bouquet	1 P
13	Preparation of Simple vase arrangement	1 P
14	Preparation of symmetrical triangle arrangement and asymmetrical crescent arrangement.	1 P
15	Visit to the botanical garden/ Flower show and festivals/Floral art museum and galleries	1 P

F.Y.B.Sc. Botany [Semester-II]
Course Category – Generic Elective / Open Elective (OE)
Course Code – OE-152-BOT-P
Course Title: Mushroom technology

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

Sr. No.	Practical	No. of Practical
1	To study the morphology of mushroom.	2 P
2	Demonstrate equipment's required for mushroom production	1 P
3	To demonstrate types of mushrooms.	1 P
4	Demonstrate preparation of spawn with the help of flow diagram	1 P
5	To Prepare any suitable bed for cultivation of Oyster mushroom	2 P
6	To demonstrate harvesting of mushrooms.	1 P
7	To perform any suitable method for mushroom preservation	1 P
8	Preparations of different types of Mushroom recipes. (Any two) Eg. Mushroom Pulao, Mushroom soup, mushroom Omelets, Mushroom Pakora, Mushroom curry, Mushroom pickles etc	4 P
9	Visit to Mushroom Growing Industry / Small scale unit and Submit the report at the time practical examination.	2 P

F.Y.B.Sc. Botany [Semester-II]
Course Category – Generic Elective / Open Elective (OE)
Course Code – OE-153-BOT-P
Course Title: Vertical and Terrace Gardening

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

Sr. No.	Practical	No. of Practical
1	Study of vertical gardening and its types.(Demonstration).	1 P
2	Study of the basic requirements used for vertical gardening.	1 P
3	Preparation of the small and large A-shaped vertical garden.	1 P
4	Preparation of a Vertical Garden with recyclable material.	1 P
5	Preparation of container based vertical gardens.	1 P
6	Preparation of kitchen waste manure for vertical gardening.	1 P
7	Preparation of hydroponic and aquaponics gardening.	1 P
8	Preparation of green roof gardening. (Demonstration).	1 P
9	Study of the permaculture and edible landscaping.	2 P
10	Preparation of herb spiral and terrace vegetable garden.	1 P
11	Study of irrigation and fertilizer application	1P
12	Visit to vertical garden/ Local nurseries and garden centers/workshops and events on vertical gardening. Submit the report at the time practical examination	2 P
13	Visit to Private residency with rooftop gardens/ Green tokri	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)	SEC-151-BOT-P	Plant Preservation Techniques	**2 C**
	SEC-152-BOT-P	Millets for Sustainable Agriculture Development	
	SEC-153-BOT-P	Plant Propagation Techniques	

F. Y. B. Sc. Botany [Semester - II]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SEC-151-BOT-P
Course Title: Plant Preservation Techniques

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

Sr. No.	Title of the Practical	No. of Practical
1	Study of tools and equipment used in plant collection.	1 P
2	Study of preparation of dried specimen using different drying methods - Air drying, Press drying, Desiccant drying, Oven drying and Glycerin drying.	3 P
3	Study of preparation of pressed specimen for herbarium preparation.	1 P
4	Demonstration of Processing of specimen with respect to Identification, Label preparation, Mounting, Accessioning.	1 P
5	Preparation of herbarium sheets of flowering plants.	1 P
6	Study of wet preservation techniques for cryptogams.	2 P
7	Study of wet preservation techniques for phanerogams.	2 P
8	Demonstration of modern preservation methods used in dry floral arrangements.	2 P
9	Visit to museum/herbarium/ plant preservation processing unit.	1 P
10	Submission of Herbarium, dried preserved specimens and wet preserved specimens.	1 P

F. Y. B. Sc. Botany [Semester - II]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SEC-152-BOT-P
Course Title: Millets for Sustainable Agriculture Development
[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Sr. No.	Title of the Practical	No. of Practical
1	To Demonstrate major and minor food yielding Crops – Cereals and millets, Pulses, Oil Seeds, Vegetables and Fibers (any 2 of each).	2 P
2	To Demonstrate the byproducts of cereals and millets - Wheat, Rice, Maize, Jowar, Bajara and Nachani.	2 P
3	To Demonstrate the byproducts of Pulses - Bengal gram, Pigeon Pea, Moong bean, Udid, Soybean.	1 P
4	To Demonstrate the edible oil yielding plants and its products- Groundnut, Safflower, Mustard, Sesame, Coconut, Sunflower, Soybean, Rice-bran	2 P
5	Visit to Traditional oil extraction plant/winery/fruit processing unit and submit visit report	2 P
6	To demonstrate the vegetables and their byproducts- as per parts used.	2 P
7	To demonstrate and uses of following spices and condiments - Turmeric, Ginger, Red Chilli, Coriander, Curry leaves, Clove, Saffron, Cardamom, Nutmeg, Cinnamon, Black pepper, Mustard, etc.	2P
8	To study the laboratory scale wine production using Banana/grapes	2P

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 Garden with the help of ICT tools.	01 P
12	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**