Savitribai Phule Pune University, Pune

(Formerly, University of Pune)

Under Graduate Degree Program in 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.

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 (Honors)	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, 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 60 marks, including optional questions. As the course is of 2 Credits (30 clock hour lectures), paper setter should allot two marks per lecture and accordingly, questions should be set for 30 lectures, 60 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 (Level 4.5 / 100)

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Vertical – 1 (V1)			
Major Core Courses – (2T + 1P) x 2C = 6C	BOT 101 MJ	Basic of Plant Sciences	**2 C**
	BOT 102 MJ	Genetics	**2 C**
	BOT 103 MJP	Practical Based on BOT 101 MJ & BOT 102 MJ	**2 C**
Major Elective Courses - (0C)	-----	------	**0 C**
Vertical – 2 (V2)			
Minor Courses - (0C)	-----	------	**0 C**
Vertical – 3 (V3)			
Generic Elective (GE) / Open Elective (OE) - (1T + 1P = 4C) (Any one from basket)	OE 101 BOT	Agro-tourism	**2 C**
	OE 102 BOT	Plants and Human Welfare	
	OE 103 BOT	Millets for Sustainable Agriculture Development	
	OEP 104 BOT	Practical Based on OE-101-BOT	**2 C**
	OEP 105 BOT	Practical Based on OE-102-BOT	
	OEP 106 BOT	Practical Based on OE-103-BOT	
Vertical – 4 (V4)			
Vocational Skill Courses (VSC) – (1T = 2C) (Any one from basket)	BOT 121 VSC	Environmental Pollution & Phytoremediation	**2 C**
	BOT 122 VSC	Biodiversity Conservation for Sustainable Development	
	BOT 123 VSC	Pharmacognosy	
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)	SECP 101 BOT	Flower Design Techniques	**2 C**
	SECP 102 BOT	Post-Harvest Technology	
	SECP 103 BOT	Algal Technology	
Vertical – 5 (V5)			
Indian Knowledge Systems (IKS) – (1T = 2C) (Any one from basket)	BOT 101 IKS	Traditional Indian Agriculture	**2 C**
	BOT 102 IKS	Role of Medicinal Plants in Indian Ayurveda	
Ability Enhancement Courses (AEC) – (1T = 2C)	AEC-101-ENG	English	**2 C**
Value Education Courses (VEC) – (1T = 2C)	VEC-101-ENV	Environmental Awareness	**2 C**
Vertical – 6 (V6)			
FP / OJT / CEP	-----	------	**0 C**
Co-curricular Courses (CC) – (1T = 2C)	CC 101 PE, NSS, NCC		**2 C**
		Total Credits (V1+V2+V3+V4+V5+V6)	**22 C**

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

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Vertical – 1 (V1)			
Major Core Courses – (2T + 1P) x 2C = 6C	BOT 151 MJ	Cell Biology	2 C
	BOT 152 MJ	Plant Biotechnology	2 C
	BOT 153 MJP	Practical Based on BOT 151 MJ & BOT 152 MJ	2 C
Major Elective Courses - (0C)	-----	------	0 C
Vertical – 2 (V2)			
Minor Courses - (1T = 2C) (Any one from basket)	BOT 191 MN	Seed Science and Technology	2 C
	BOT 192 MN	Crop Science	
Vertical – 3 (V3)			
Generic Elective (GE) / Open Elective (OE) - (1T + 1P = 4C) (Any one from basket)	OE 151 BOT	Mushroom technology	2 C
	OE 152 BOT	Entrepreneurship & Business management in Plant Sciences	
	OE 153 BOT	Applications of Pollen Diversity in Bee Keeping	
	OEP 154 BOT	Practical Based on OE-151-BOT	2 C
	OEP 155 BOT	Practical Based on OE-152-BOT	
	OEP 156 BOT	Practical Based on OE-153-BOT	
Vertical – 4 (V4)			
Vocational Skill Courses (VSC) – (1T = 2C) (Any one from basket)	BOT 171 VSC	Fruit Processing & Dehydration Technology	2 C
	BOT 172 VSC	Organic Farming	
	BOT 173 VSC	Biofertilizer Production Technology	
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)	SECP 151 BOT	Plant Preservation Techniques	2 C
	SECP 152 BOT	Computer Literacy & Basics of MS Office	
	SECP 153 BOT	Plant Propagation Techniques	
Vertical – 5 (V5)			
IKS - (0C)	-----	------	0 C
Ability Enhancement Courses (AEC) – (1T = 2C)	AEC-151-ENG	English	2 C
Value Education Courses (VEC) – (1T = 2C)	VEC-151-ENV	Environmental Awareness	2 C
Vertical – 6 (V6)			
FP / OJT / CEP – (0C)	-----	------	0 C
Co-curricular Courses (CC) – (1T = 2C)	CC 151 PE, NSS, NCC		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 (UG Certificate Course in Botany) in Major and Minor with 44 Credits and an additional 4 Credits core NSQF course / Internship OR Continue with Major and Minor.

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Vertical – 1 (V1)			
Major Core Courses – (2T + 1P) x 2C = 6C	BOT 101 MJ	Basic of Plant Sciences	**2 C**
	BOT 102 MJ	Genetics	**2 C**
	BOT 103 MJP	Practical Based on BOT 101 MJ & BOT 102 MJ	**2 C**

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

Course Category - Major Core Course (MJ)

Course Code - BOT 101 MJ

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 – Lower Cryptogams	**15**
1	**Introduction** 1.1. Introduction to plant diversity, Definition. 1.2. General Outline Classification of Plant Kingdom.	**01**
2	**Algae** 2.1. Introduction and General characters of Algae. 2.2. Outline classification of Algae as per G.M. Smith (1955) up to the classes with reasons. 2.3. Study of *Spirogyra* - Systematic position, Habitat, Structure of typical cell w.r.t. thallus organization. 2.4. Reproduction in *Spirogyra*- Vegetative, Asexual and Sexual.	**04**
3	**Fungi** 3.1. Introduction and General characters of Fungi. 3.2. Outline classification of Fungi as per Alexopolous (1972) up to the classes with reasons. 3.3. Study of *Agaricus bisporus* - Systematic position, Habitat, Thallus structure w.r.t. sporocarp and Gill. 3.4. Reproduction in *A. bisporus* - Asexual and Sexual.	**04**
4	**Lichens** 4.1. Introduction and General characters of Lichens. 4.2. Forms of lichens – Crustose, Foliose and Fruticose. 4.3. Economic importance of lichens.	**02**
5	**Bryophytes** 5.1. Introduction and General characters of Bryophytes. 5.2. Outline classification of Bryophytes as per G.M. Smith (1955) up to the classes with reasons. 5.3. Study of *Riccia* - Systematic position, Habitat, Thallus structure – External and Internal. 5.4. Reproduction in *Riccia* – Vegetative, Asexual and Sexual.	**04**
	Credit II – Higher Cryptogams and Phanerogams	
6	**Pteridophytes** 6.1. Introduction and General characters of Pteridophytes. 6.2. Outline classification of Pteridophytes according to Sporne (1976) up to the classes with reasons. 6.3. Study of *Nephrolepis* - Systematic position, Habitat, External morphology of Sporophyte w.r.t. root, stem and leaf; Internal morphology of rachis. 6.4. Reproduction in *Nephrolepis* – Vegetative, Asexual and Sexual.	**06**
7	**Gymnosperms** 7.1. Introduction and General characters of Gymnosperms. 7.2. Outline classification of Gymnosperms according to Sporne (1976) up	**06**

	to the classes with reasons. 7.3. Study of *Cycas* - Systematic position, Habitat, External morphology of Sporophyte w.r.t. root, coralloid roots, stem and leaf; Internal morphology of leaflet. 7.4. Reproductive organs in *Cycas* – Male Cone – Microsporophylls, Microsporangia and microspores; Megasporophyll, Megasporangia, megaspore; Structure of ovule and seed.	
8	**Angiosperms** 8.1. Introduction and General characters of Angiosperms. 8.2. Outline classification of Angiosperms as per Bentham and Hooker. 8.3. Difference between classes of angiosperms – Dicotyledonous and Monocotyledonous plants.	**03**

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

Course Category - Major Core Course (MJ)

Course Code - BOT 102 MJ

Course Title: Genetics

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

Sr. No.	Topic Details	No. of Lectures
	Credit I – Mendelian Genetics	**15**
1	**Introduction to Genetics** 1.1. History, Concept and Definition. 1.2. Genetic Terminologies- Gene, Genome, Allele, Locus, Traits, Genotype, Phenotype, Dominant, Recessive, Co-dominance, Heredity, Inheritance, Variation, Homozygous, Heterozygous 1.3. Applications of Genetics.	**03**
2	**Mendelian Genetics - I** 2.1. Monohybrid Cross. 2.2. Law of Dominance and Law of Segregation. 2.3. Incomplete Dominance. 2.4. Co-Dominance.	**04**
3	**Mendelian Genetics –II** 3.1. Dihybrid Cross. 3.2. Law of Independent Assortment. 3.3. Back Cross. 3.4. Test Cross.	**04**
4	**Multiple Alleles** 4.1. Introduction, Definition and Concept. 4.2. Characteristics of Multiple Alleles. 4.3. Self-Incompatibility in *Nicotiana*. 4.4. ABO Blood Group in Humans.	**04**
	Credit II – Inheritance and Mutation	
5	**Cytoplasmic Inheritance** 5.1. Introduction, Definition and Concept. 5.2. Chloroplast: Variegation in Four O 'Clock Plant.	**02**
6	**Quantitative Inheritance** 6.1. Introduction, Definition and Concept. 6.2. Example: Cob Length in Maize. 6.3. Difference between Quantitative and Qualitative Traits.	**03**
7	**Linkage and Crossing Over** 7.1. Linkage: Concept and Definition. 7.2. Types: Complete and Incomplete Linkage. 7.3. Crossing Over: Concept and Definition. 7.4. Types : Single and Double Crossing Over.	**04**
8	**Sex linked Inheritance** 8.1. Concept and Definition. 8.2. Sex Chromosomes and Autosomes. 8.3. Inheritance of X -linked Genes: Colorblindness in Humans. 8.4. Inheritance of Y-Linked Genes: Hypertrichosis.	**04**
9	**Mutation** 9.1. Introduction, Definition and Concept.	**02**

	9.2. Types: Spontaneous and Induced Mutations.	

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F. Y. B. Sc. Botany [Semester - I]
Course Category - Major Core Course (MJ)
Course Code - BOT 103 MJP
Course Title: Practical Based on BOT 101 MJ and BOT 102 MJ

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

Sr. No.	Title of the Practical	No. of Practical
	Credit I – Practical Based on BOT 101 MJ	
1	Study of plant group Algae w.r.t. thallus and cell structure of *Spirogyra.*	**1 P**
2	Study of plant group Fungi w.r.t. thallus structure of *Agaricus.*	**1 P**
3	Study of forms of lichens on the basis of their external morphology.	**1 P**
4	Study of plant group Bryophytes w.r.t. external and internal thallus structure of *Riccia.*	**1 P**
5	Study of Plant group Pteridophytes w.r.t. sporophyte of *Nephrolepis* - External morphology and Internal morphology of Rachis and leaflet/ pinna passing through sorus.	**1 P**
6	Study of Plant group Gymnosperms w.r.t. sporophyte of *Cycas* - External morphology and Internal morphology of leaflet / pinna.	**1 P**
7	Study of comparative account of Dicotyledonous and Monocotyledonous plants with suitable examples.	**1 P**
8	Botanical Excursion to nearby locality to study the vegetation and diversity among various plant groups.	**1 P**
	Credit I – Practical Based on BOT 102 MJ	
9	Study of monohybrid and dihybrid crosses with suitable example (Pea Plant). (Ex. What will be the appearance of F1 & F2 progenies when a pure tall pea plant is crossed with a pure dwarf pea plant?) (Ex. A Yellow (YY) seeded pea plant with Round (RR) seed was crossed with plants with Green (yy) & Wrinkled (rr) seeds. What will be the genotype and phenotype in F1 & what will be the genotype and phenotype in F2.)	**1 P**
10	Study of Incomplete dominance with suitable example. (Ex. In Snapdragon, homozygous flowers may be red or white. The heterozygous flowers are pink. What would be the genotype and phenotype of F2 generation?)	**1 P**
11	Problems on multiple alleles. Ex. A man with AB blood is married to a woman with AB blood. What blood types will their children be & in what proportion? (Ex. A man with type A blood (unknown genotype) marries a woman with type O blood. What blood types are possible among their children?)	**1 P**
12	Study of Cytoplasmic inheritance in *Mirabilis jalapa*. (plastid inheritance) (Ex. What would be the possible phenotype if variegated female plant is crossed with green male plant?)	**1 P**
13	Study of Quantitative inheritance with suitable example. (Cob Length in Maize, Ear length in Bajra) (Ex. In wheat, homozygous dominant gene shows red color to the kernel and homozygous recessive gene shows white color to the kernel. What would be the phenotypic ratio of F2 generation?)	**1 P**
14	Study of chlorophyll mutation. (Demonstration)	**1 P**

15	Study of Sex linked inheritance. (Demonstration) Ex. Colorblindness and hypertrichosis. (Ex. Colorblindness is X- linked recessive inheritance trait. What is the possible phenotype, if carrier female married to normal male?)	**1 P**

F.Y. B. Sc. Botany
Semester – I

COURSE DETAILS	COURSE CODE	COURSE TITLE	CREDITS
Vertical – 3 (V3)			
Generic Elective (GE) / Open Elective (OE) - (1T + 1P = 4C) (Any one from basket)	OE 101 BOT	Agro-tourism	**2 C**
	OE 102 BOT	Plants and Human Welfare	
	OE 103 BOT	Millets for Sustainable Agriculture Development	
	OEP 104 BOT	Practical Based on OE-101-BOT	**2 C**
	OEP 105 BOT	Practical Based on OE-102-BOT	
	OEP 106 BOT	Practical Based on OE-103-BOT	

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

Course Category – Open Elective / Generic Elective (OE)

Course Code – OE 101 BOT

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. Needs and opportunities of agro-tourism. 1.3. History of Agro-Tourism	**03**
2	**Agro-Tourism** 2.1. Types of agro-tourism. 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	
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. 6.9. Performa for police verification.	**07**
7	**Tourism Marketing strategy**	**03**

	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.	

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

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.
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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
Course Title: Millets for Sustainable Agricultural Development

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Millets** 1.1. Introduction, Definition, History of millets in India. 1.2. Journey of millets to India and millets of Indian origin. 1.3. Introduction of Millets with reference to - Sorghum, Pearl millet, Finger millet, Foxtail millet, Proso millet, Barnyard millet, Kodo millet, Little millet, Brown top millet, Tef and Fonio.	**04**
2	**Current Scenario of Millets in India** 2.1. Production Scenario of millet at National and International market. 2.2. Consumption pattern of Millets in India. 2.3. Problems associated with rise and fall of millets production. 2.4. Exports and Imports of Millets.	**04**
3	**Nutritional Status of Millets** 3.1. Nutritional composition of millets. 3.2. Importance of millets in human diet and its health benefits. 3.3. Anti-nutritional compounds in millets and its effect on human health. 3.4. Challenges and solutions to anti-nutritional compounds in millets.	**04**
4	**Utilization of millets** 4.1. Millets as source of conventional food. 4.2. Utilization of millets for production of processed food products. 4.3. Millets as source of animal feed and fodder. 4.4. Millets for green forage.	**03**
	Credit II	
5	**Millet Agriculture** 5.1. Introduction, scope and importance. 5.2. Genetic diversity with reference to Sorghum and Finger millets. 5.3. Importance of millet landraces with reference to crop diversity and climate change. 5.4. Sustainable Development Goals related to millet agriculture. 5.5. Policy framework for promoting millet cultivation in India. 5.6. Initiatives and collaborations required for promotion of millet research.	**06**
6	**Millet research – Indian Scenario** 6.1. Introduction to millet research institutes – ICRISAT, Hyderabad; Indian Institute of Millet Research, Hyderabad; CFTRI, Mysore. 6.2. R & D efforts and policy push for millets in India.	**03**
7	**Millet Bioprocessing** 7.1. Introduction, Definition and Importance. 7.2. Types of Bioprocessing. 7.3. Malting and Fermentation of millets.	**06**

	7.4. Changes occurs during the processing. 7.5. Nutritional Recipes and Value addition. 7.6. Design of products and marketing. 7.7. Health benefits and applications.	

References:

1. Millets - the miracle Ancient Grains, Author - Tapas Chandra Roy
2. MILLETS: THE ORPHAN CROP FOR UNCERTAIN FUTURE. Author - R R Kumar et. al.
3. The story of millets - Booklet by Karnataka State Department of Agriculture

F. Y. B. Sc. Botany [Semester - I]
Course Category – Open Elective (OE) / Generic Elective (GE)
Course Code – OEP 104 BOT
Course Title: Practical based on OE 101 BOT

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

Sr. No.	Title of the Practical	No. of Practical
1	Field Visit/Study: Field visits to major local agro-tourism centers.	3 P
2	Survey for the establishments of Agrotourism centers with major emphasis on comparative statements of all components involved in Agrotourism - costing and pricing. – **Onsite Visit and Report writing**	3 P
3	To prepare the proposal for Agrotourism center as per the guidelines of Govt. of Maharashtra - Maharashtra Krishi Paryatan Vistar Yojana-MKPVY.	3 P
3	Survey of brochure of different Agro-tourism centers and design the model brochures (Social and Print Media) for establishment of agrotourism center - **Report writing**	3 P
4	Study of different plant based agroproducts – Hurda, Maize (Bhutta), Fruit Juice, Wild vegetable, Raan mewa, sugarcane etc.	1 P
5	Enlisting of any four Agro-tourism centers (2 from Maharashtra and 2 outside the State) and write information for booking the sites (Tickets and booking center).	2 P

F. Y. B. Sc. Botany [Semester - I]
Course Category – Open Elective (OE) / Generic Elective (GE)
Course Code – OEP 105 BOT
Course Title: Practical based on OE 102 BOT

[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 - I]
Course Category - Open Elective (OE) / Generic Elective (GE)
Course Code – OEP 106 BOT
Course Title: Practical based on OE 103 BOT

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

Sr. No.	Title of the Practical	No. of Practical
1	To study the millet diversity among the local study area with reference to botanical name, common name, variety / landraces, growth season and cultivation practices.	1 P
2	Hands-on sowing different millet seeds in pots or field and monitoring the growth stages.	1 P
3	Study on nutritional analysis of different millet grain samples w.r.t. protein, carbohydrates, and vitamins.	2 P
4	Study on mineral analysis of millets for essential mineral nutrients.	1 P
5	To study the anti-nutritional compounds in millets.	1 P
6	Study on identification of common pests and diseases affecting millet crops.	1 P
7	To study the application of Integrated Pest Management (IPM) techniques for sustainable millet production.	1 P
8	To study the bioprocessing techniques w.r.t. malting and fermentation.	1 P
9	Study on development of millet-based food product w.r.t value addition and sensory analysis.	1 P
10	Study on development of millet-based food products for animal feed.	1 P
11	Preparation of different food recipes and dishes from millets.	1 P
12	Project work – Collection, identification, and preservation of millet landraces.	1 P
13	Field visit to nearby local millet farm to study and observe different millet varieties and cultivation practices and submission of field visit report.	1 P
14	Visit to millet research institute and submission of visit report.	1 P

F.Y. B. Sc. Botany
Semester – I

Vertical – 4 (V4)			
Vocational Skill Courses (VSC) – (1T = 2C) (Any one from basket)	BOT 121 VSC	Environmental Pollution & Phytoremediation	**2 C**
	BOT 122 VSC	Biodiversity Conservation for Sustainable Development	
	BOT 123 VSC	Pharmacognosy	
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)	SECP 101 BOT	Flower Design Techniques	**2 C**
	SECP 102 BOT	Post-Harvest Technology	
	SECP 103 BOT	Algal Technology	

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

Course Category - Vocation Skill Courses (VSC)

Course Code - BOT 121 VSC

Course Title: Environmental Pollution and Phytoremediation

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

Sr. No.	Topic Details	No. of Lectures
	Credit I - Environmental Pollution	**15**
1	**Environmental Pollution** 1.1. Introduction and Definition. 1.2. Concept. 1.3. Sources of pollution.	**02**
2	**Pollution** 2.1. Introduction. 2.2. Nature, Causes, and type of pollutants. 2.3. Pollution monitoring. 2.4. Effects of Air, Water, and Soil pollution on vegetation and its control. 2.5. Noise Pollution and its control.	**05**
3	**Heavy Metal Pollution** 3.1. Introduction. 3.2. Source, Causes, and control. 3.3. Bioaccumulation and biomagnification of heavy metals. 3.3. Effects on plant health and its mitigation.	**04**
4	**Solid Waste Pollution** 4.1. Introduction, causes, types, and characteristics. 4.2. Effects on plants. 4.3. Monitoring and management. 4.4. Control, Treatment, and Disposal. 4.5. Solid Waste Management Rules.	**04**
	Credit II - Phytoremediation	**15**
5	**Introduction** 5.1. Definition. 5.2. Scope. 5.3. Importance. 5.4. Hyper-accumulator species.	**02**
6	**Types of Phytoremediation** 6.1. Phytostabilization. 6.2. Phytoextraction. 6.3. Phytovolatilization. 6.4. Phytodegradation. 6.5. Phytofiltration. 6.6. Hyper-accumulators and biotic interactions.	**05**
7	**Phytoremediation of pesticides** 7.1. Introduction. 7.2. Pesticides categories.	**04**

	7.3. Impact of pesticides on natural resources. 7.4. Plant-associated remediation of pesticides. 7.5. Biopesticides scenario.	
8	**Microbe Assisted phytoremediation** 8.1. Introduction. 8.2. Microbial diversity. 8.3. Mechanisms of microbe-assisted phytoremediation. 8.4. Transgenic approach.	**04**

References:

1. Avnish Chauhan (2019) Environmental Pollution and Management, Wiley India.
2. C.S. Rao (2021) Environmental Pollution Control Engineering, NEW AGE International Publishers.
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F. Y. B. Sc. Botany [Semester - I]
Course Category - Vocation Skill Courses (VSC)
Course Code - BOT 122 VSC
Course Title: Biodiversity Conservation for Sustainable Development

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Biodiversity** 1.1. Biodiversity: Definition, Types of diversity. 1.2. Species diversity: Definition, Concept, scope and types: Alpha, Beta and Gamma diversity. 1.3. Genetic diversity: Definition, Nature and origin of genetic variations. 1.4. Species diversity: Definition, origin of species diversity. 1.5. Ecosystem diversity: Definition, Structure and function of ecosystems; Energy flow in an ecosystem, food chains and webs. 1.6. Major ecosystems: a) Terrestrial: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Alpine ecosystems, Croplands; b) Aquatic ecosystems: Ponds, Streams, Lakes, Rivers, Oceans, Estuaries	**10**
2	**Sustainability of biodiversity and Sustainable Development** 2.1. Concept of sustainability and sustainable development. 2.2. Human impact on Natural Resources. 2.3. Threats (Challenges) to Sustainable Development. 2.4. Principles of Sustainable Development. 2.5. Sustainable Development in India. 2.6. Perspectives and Challenges.	**05**
	Credit II	**15**
3	**Assessment of Biodiversity for Sustainability** 3.1. Importance of Biodiversity. 3.2. Biodiversity Assessments: a) IUCN Categories and criteria for plant and animal diversity assessment b) Threat assessment as per IUCN c) Biological monitoring, d) Threats to Biodiversity: Habitat loss, Poaching of wild life, man-wildlife conflicts, Biological invasions. e) Environmental Impact Assessment (EIA): EIA Process: Screening, scoping, Assessment and Evaluation of Impacts and development of Alternatives. EIA: Reports /Statement: Ethics for EIA report generation. Importance of EIA report Agencies involved- 1. Accredited Environment Impact Assessment Consultant Organization (ACO) 2. Central Pollution Control Board 3. Corporate sector (Industry which requires the report for submission) 4. MoEF & CC.	**10**

4	**Methods of Biodiversity Conservation** 4.1. Concept of conservation. 4.2. Endemism: Concept, Causes and Endemic plants and animals in India. 4.3. Historical /Ancient Methods of conservation: Social and traditional ways, Chipko Andolan. 4.4. Status of Biodiversity Conservation in India. 4.5. Measures of Conservation: Social responsibilities, Legal framework, Biodiversity protection acts and Laws, Government agencies for conservation- MoEF & CC, Biodiversity Board at National and State Level. State Forest Department and its framework. 4.6. Methods of Conservation: *In-situ* and *Ex- situ* enlisting. 4.7. Study of National parks, Biosphere reserve programs, Botanical gardens and importance. 4.8. Wildlife special Project: Cheetah- Reintroduction in India, Advantages, Challenges, Kuno National Park, Madhya Pradesh.	**05**

References:

1. Ecology and Environment by P.D. Sharma 13th Edition, RASTOGI PUBLICATIONS.
2. A Text Book of Plant Ecology By R.S. Shukla And P.S. Chandel, S CHAND & COMPANY LTD.
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F. Y. B. Sc. Botany [Semester - I]
Course Category - Vocation Skill Courses (VSC)
Course Code - BOT 123 VSC
Course Title: Pharmacognosy

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Pharmacognosy** 1.1. Introduction. 1.2. Definition and Concept. 1.3. Scope of pharmacognosy.	**02**
2	**Ethnobotany** 2.1. Introduction. 2.2. Definition and scope of ethnobotany. 2.3. Impact of Ethnobotany in traditional medicine.	**03**
3	**Indian Systems of Medicine** 3.1. Introduction. 3.2. Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy. 3.3. Current status of Indian systems of medicine.	**03**
4	**Classification of Drugs of natural origin**	**03**
5	**Medicinal Herbal Drugs** 5.1. Preparation of herbal drugs for commerce: Asava, Arishta and Churna with examples. 5.2. Role of medicinal plants in National Economy - Export potential of Indian medicinal herbs; Indian Medicinal plants used in aromatherapy, Spices and condiments and their export.	**04**
	Credit II	**15**
6	**Industries and institutions involved in work on medicinal and aromatic plants in India.**	**02**
7	**Study of following plants with respect to their vernacular name, Botanical name, Family, Industrial applications and commercial products:** Brahmi [*Bacopa monnieri* (L.) Pennell], Shatavari [*Asparagus racemosus* Willd.], Guduchi [*Tinospora cordifolia* (Thunb.) Miers], Aloe [*Aloe vera* (L.) Burm.f.], Amala [*Phyllanthus emblica* L.]	**06**
8	**Study of following essential oil yielding plants with respect to their vernacular name, Botanical name, Family and Industrial applications:** Definition and Characters of essential oil, Basil [*Ocimum basilicum* L.], Eucalyptus [*Eucalyptus oblique* L'Hér.]), Jasmine [*Jasminum officinale* L.], Cloves [*Syzygium aromaticum* (L.) Merr. & L.M.Perry], lemongrass [*Cymbopogon schoenanthus* (L.) Spreng]	**04**

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2. Tyler, Varro E.; Brady, Lynn R.; Robbers, James E. (1988) Pharmacognosy. Lea & Febiger, USA
3. Wallis T.E. (2005) Text Book of Pharmacognosy, 5Th Edition, CBS.
4. Kokate C.K., Purohit A.P. and Ghokhale S.B (1996.) Text book of Pharmacognosy. Nirali Prakasshan, Pune
5. Pereda-Miranda R. and de Moraes S. C. A. (2021) Trends in Pharmacognosy: 35 Years of Research on Therapeutical Natural Resources. Revista Brasileira de Farmacognosia 31, 503–504.

F. Y. B. Sc. Botany [Semester - I]
Course Category – Skill Enhancement Course (SEC)
Course Code – SECP 101 BOT
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 – SECP 102 BOT
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 – SECP 103 BOT
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
15	Submission of any five algal herbarium specimens or digital photomicrograph and tour report is essential.	1P

F.Y. B. Sc. Botany
Semester – I

Vertical – 5 (V5)			
Indian Knowledge Systems (IKS) – (1T = 2C) (Any one from basket)	BOT 101 IKS	Traditional Indian Agriculture	**2 C**
	BOT 102 IKS	Role of Medicinal Plants in Indian Ayurveda	
Ability Enhancement Courses (AEC) – (1T = 2C)	AEC-101-ENG	English	**2 C**
Value Education Courses (VEC) – (1T = 2C)	VEC-101-ENV	Environmental Awareness	**2 C**

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

Course Category – Indian Knowledge System (IKS)

Course Code - BOT 101 IKS

Course Title: Traditional Indian Agriculture

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Traditional Indian Agriculture** 1.1. History and development of traditional Indian agriculture. 1.2. Different types of traditional Indian agriculture. 1.3. Importance of traditional Indian agriculture.	**05**
2	**Agricultural Heritage** 2.1. Past and present status of agriculture and farmers in society. 2.2. Journey of Indian agriculture and its development from past to modern era. 2.3. Plant production and protection through indigenous traditional knowledge.	**05**
3	**Traditional Practices** 3.1. Traditional land management practices in India. 3.2. Soil conservation, water management, and pest control. 3.3. Forest, Sacred Groves, Water Mills, Sacred Water Bodies.	**05**
	Credit II	
4	**Irrigation Methods in Ancient India** 4.1. Agriculture and irrigation in the era of different Kings of Indian tradition. 4.2. Major water reservoirs of ancient times. The Ery system of south India. 4.3. Excellence of Indian agricultural technologies for sustainable development.	**08**
5	**Socio-Economic Aspects of Traditional Indian Agriculture** 5.1. Role of traditional Indian agriculture in the Indian economy. 5.2. Social and cultural significance of traditional Indian agriculture. 5.3. Challenges faced by traditional Indian agriculture.	**07**

References:

1. Dying Wisdom: Rise, Fall and Potential of India Traditional Water-Harvesting Systems. Agarwal, A., Narain, S. Centre for Science and Environment, New Delhi. (1997).
2. History of Science in India - Agricultural Science (Volume V). Basu, R. N., Bose, T. K., Chakraborty, C. S. The National Academy of Science, India (NASI) & The Ramakrishna Mission Institute of Culture, India. (2017).
3. Irrigation and Water Supply: South India, 200 BC to 1600 AD. Srinivasan, T. M. South Asia Books, Hyderabad. (1991).
4. Lokopakara (For the Benefit of People) - An Ancient Text on Indian Agriculture Ayangarya, V. S. Asian Agri-History Foundation, India. (2006).

5. The Ery Systems of South India. Mukundan, T. M. Akash Ganga Trust, Chennai. (2005).
6. The Iconography of Water: Well and Tank Forms of the Indian Subcontinent. Bunce, F. W. D. K. Printworld Pvt. Ltd., New Delhi. (2013).
7. Traditional Water Management Systems of India. Chakravarty, K. K., Badam, G. L., Paranjpye, V. Aryan Books International, New Delhi. (2006).
8. Water Harvesting, Conservation and Irrigation in Mewar (AD 800-1700). Bhadani, B. L. Manohar Publishers & Distributors, New Delhi. (2012).

F. Y. B. Sc. Botany [Semester - I]
Course Category – Indian Knowledge System (IKS)
Course Code - BOT 102 IKS
Course Title: Role of Medicinal Plants in Indian Ayurveda

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Introduction to Ayurveda** 1.1. Introduction, Origin, History, Definition and scope of Ayurveda. 1.2. Basic Terminologies: Ayurveada, Ashtanga of Ayurveda, Swastha, Dosha, Dhatu, Mala, Srothas, Kala, Desa, Agni, Panchabhootha, Tridosha, Vata, Pitta, Kapha, Oushadha, Kalpana. 1.3. Methods of classification and their significance in the study of drugs of natural origin with respect to alphabetical, biological, chemical, chemo-taxonomical, pharmacological and taxonomical characters.	**04**
2	**Ayurvedic Pharmacy** 2.1. Introduction, concept and importance. 2.2. Ayurvedic formulations: Asava, Arishta, Kvatha, Churna, Ksharas, Leha, Guti, Vatika, Taila, Bhasma. 2.3. Tridosha concept, Humoral, Indigenous systems of medicine - Ayurveda, Siddha, Unani, Tibi, Chinese and Ayusha.	**06**
3	**Analytical Pharmacognosy** 3.1. Drug adulteration. 3.2. Methods of drug evaluation - Morphological, Microscopic, Chemical and Physical. 3.3. Methods of extraction - percolation, maceration and soxhlet extraction of different classes of phytochemicals of crude drugs.	**05**
	Credit II	
4	**Study of Drugs** 4.1. Study of drugs with respect to occurrence, distribution cultivation, microscopic characters, constituents and uses of the following: a. Root Rhizome Drugs: *Glycyrrhiza*, *Asparagus*. b. Stem Drugs: *Ephedra, Tinospora.* c. Bark Drugs: - *Cinnamon, Cinchona.* d. Leaf Drugs: - *Aloe, Adulsa.* e. Flower Drugs: - *Woodfordia, Clove.* f. Fruit Drugs: - *Coriandrum, Amla.* g. Seed Drugs: - *Myristica, Isabjhol.* h. Unorganized Drugs :- *Acacia Gum, Asafoeitida.*	**07**
5	**Cultivation, Collection and Processing of Herbal Drugs** 5.1. Cultivation- Methods, Factors affecting cultivation. 5.2. Collection and Processing Collection, harvesting, drying, garbling, packing, storage of crude drugs.	**04**
6	**Ethno-botany** 6.1. Introduction, Definition, concepts and relevance. 6.2. Branches of Ethno-botany. 6.3. Methodology, importance of Ethnobotany in research and	**04**

	conservation. 6.4. Ethnic Societies of India and world & their contribution	

References:

1. Gokhale and Kokate (2009) Pharmacognosy, Nirali Publication.
2. Kokate,C.K, A P Purohit and S B Gokhale.(2017). Pharmacognosy Nirali Publication.
3. Kuntal Das.(2020).Pharmacognosy And Phytochemistry -- I ,Nirali Publication.
4. Bharti Chaudhry (2018) A Handbook of Common Medicinal Plants Used in Ayurveda Kojo Press Publication.
5. Debabrata Das (2023) Medicinal Plants and Traditional Knowledge in the Indian Subcontinent, Shashwat Publication.

F.Y. B. Sc. Botany
Semester – II

Vertical – 1 (V1)			
Major Core Courses – (2T + 1P) x 2C = 6C	BOT 151 MJ	Cell Biology	**2 C**
	BOT 152 MJ	Plant Biotechnology	**2 C**
	BOT 153 MJP	Practical Based on BOT 151 MJ & BOT 152 MJ	**2 C**

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

Course Category - Major Core Course (MJ)

Course Code - BOT 151 MJ

Course Title: Cell Biology

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

Sr. No.	Topic Details	No. of Lectures
	Credit I - Cell and Cell Organelles	**15**
1	**Cell Biology** 1.1. Introduction, Definition, Brief History. 1.2. Units of measurement of cells. 1.3. Cell as unit of structure and function. 1.4. Characteristics of Prokaryotic and Eukaryotic cells. 1.5. Typical structure of plant cell.	**03**
2	**Cell Organelles - structure and Functions of following cell organelles** 2.1. Cell wall and Plasma membrane 2.2. Mitochondria and Chloroplast 2.3. Endoplasmic Reticulum and Golgi apparatus 2.4. Lysosomes and Ribosomes 2.5. Peroxisomes and Glyoxysomes.	**08**
3	**Nucleus** 3.1. Introduction and definition. 3.2. Morphology and structure of Nucleus, Nucleolus and Nuclear Membrane: Nuclear Pore Complex. 3.3. Functions of nucleus	**04**
	Credit II – Chromosomes, DNA and Cell Cycle	**15**
4	**Chromosomes** 4.1. Introduction. 4.2. Structure of Typical Chromosomes. 4.3. Types of Chromosomes - Telocentric, Acrocentric, Sub-metacentric, and Metacentric. 4.4. Euchromatin and Heterochromatin. 4.5. Types of Giant chromosomes: Polytene and Lampbrush chromosomes.	**05**
5	**DNA and Chromosome Organization** 5.1. Introduction. 5.2. Chemical Composition and Structure of DNA (Watson and Cricks Model). 5.3. Forms of DNA (A, B, and Z). 5.4. Histone proteins. 5.5. Packaging of DNA in Chromosome in Eukaryotes.	**05**
6	**Cell Cycle** 6.1. Introduction. 6.2. Stages / Phases of Cell Cycle – Mitosis and Meiosis. 6.3. Divisional stages of Mitosis.	**05**

	6.4. Divisional stages of Meiosis. 6.5. Importance of Cell cycle in plants.	

References:

1. Cell and Molecular Biology, S.C. Rastogi.
2. Cytology, T.S. Verma and V.K. Agarwal.
3. Cell Biology, C.B. Powar.
4. Cell and Molecular Biology, P.K. Gupta.
5. Cell and Molecular Biology, Robertis and De Robertis.
6. Molecular Cell Biology, 4 Edition Lodish S. Baltimore.
7. Fundamentals of Molecular Biology, Veer Bala Rastogi.
8. Fundamentals of Molecular Biology G.K. Pal and Ghaskadbi.
9. Fundamentals of Genetics, B.D. Singh.

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

Course Category - Major Core Course (MJ)

Course Code - BOT 152 MJ

Course Title: Plant Biotechnology

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Plant Biotechnology** 1.1. Introduction, Definition and Brief History. 1.2. Scope and importance of plant biotechnology.	**03**
2	**Single Cell Protein (SCP) Production Technology** 2.1. Introduction, Concept and Definition. 2.2. Importance of protein in diet. 2.3. Production of SCP from *Spirulina* and Yeast. 2.4. Importance and acceptability of SCP.	**04**
3	**Fermentation Technology** 3.1. Introduction, History, Definition, and concept of fermentation. 3.2. Organism involved in fermentation process; concept of media preparation for fermentation. 3.3. Solid and liquid state fermentation. 3.4. Types of fermentation products and their outputs. 3.5. Principles of microbial growth. 3.6. Types of culture – Batch culture – phases of microbial growth in batch culture; Continuous culture. 3.7. Bioreactor (Fermenters) – Definition and its process of fermentation in bioreactor; Types of Bioreactors -Tubular, stirred tank and Digestive Tank, Activated sludge bioreactor. 3.8. Concept of scaling up. 3.9. Downstream processing.	**08**
	Credit II	**15**
4	**Enzyme Technology** 4.1. Introduction, Definition, nature of enzyme. 4.2. Properties and classification of enzymes. 4.3. Industrial applications of enzymes. 4.4. Importance and commercial production of amylases, proteases and lipases w.r.t source organism, substrate, growth conditions and purification of enzyme. 4.5. Enzyme immobilization – concept and definition. 4.6. Immobilization Techniques / methods – a) Chemical – Adsorption; covalent bonding – support and cross linking; b) Physical – Entrapment and Encapsulation.	**08**
5	**Biofuel Technology** 5.1. Introduction and Definition. 5.2. Concept and types of Renewable and non-renewable energy sources. 5.3. Definition, Concept and production of Biogas, Bioethanol, Biobutanol, Biodiesel and Biohydrogen.	**07**

	5.4. Advantages and disadvantages of biofuel production.	

References:

1. B.D. Singh (4th Edn 2012) Biotechnology-expanding horizons, Kalyani Publishers.
2. K.S. Bilgrami & A. K. Pandey (2007) Introduction to Biotechnology CBS Publishers and Distributors PVT LTD.
3. 4. H.S. Chawala (2005) Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. New Delhi.

F. Y. B. Sc. Botany [Semester - II]
Course Category - Major Core Course (MJ)
Course Code - BOT 153 MJP
Course Title: Practical Based on BOT 151 MJ and BOT 152 MJ

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

Sr. No.	Title of the Practical	No. of Practical
	Credit I – Practical Based on BOT 151 MJ	
1	Study of Microscope – Dissecting and Compound.	**1 P**
2	Study of preparation of fixative and nuclear staining reagents (Aceto-orcine and Acetocarmine).	**1 P**
3	Study of demonstration of prokaryotic and eukaryotic cell structure.	**1 P**
4	Study of demonstration of structure of Nucleus, DNA, chloroplast and Mitochondria	**1 P**
5	Study of various stages of Mitosis with the help of suitable plant material.	**1 P**
6	Study of various stages of Meiosis with the help of suitable plant material.	**1 P**
7	Study of Polytene chromosome with suitable material.	**2 P**
	Credit II – Practical Based on BOT 152 MJ	
8	Study of demonstration of SCP products.	**1 P**
9	Study of fermentation process using Yeast and its products.	**2 P**
10	Study of demonstration of fermentation products.	**1 P**
11	Study of methods of enzyme immobilization.	**1 P**
12	Study of any one biofuel production with suitable material.	**1 P**
13	Visit to Biotechnology industry.	**1 P**

F.Y. B. Sc. Botany
Semester – II

Vertical – 2 (V2)			
Minor Courses - (1T = 2C) (Any one from basket)	BOT 191 MN	Seed Science and Technology	**2 C**
	BOT 192 MN	Crop Science	

F.Y.B.Sc. Botany [Semester-II]
Course Category – Minor Core Course (MN)
Course Code – BOT 191 MN
Course Title: Seed Science and Technology
[No. of Credits: 2 C] **[No. of Lectures: 30 L]**

Sr. No.	Topic Details	No. of Lectures
	Credit I - SEED SCIENCE	**15**
1	**Flower** 1.1. Definition. 1.2. Parts of typical flower 1.3. Study of flower with reference to following families (Any one suitable crop from each family): Malvaceae; Fabaceae; Solanaceae; Cucurbitaceae; Liliaceae; Poaceae.	**04**
2	**Microsporangium** 2.1. Definition. 2.2. Structure (T.S of typical anther). 2.3. Development of microspore and male gametophyte.	**02**
3	**Megasporangium** 3.1. Definition. 3.2. Structure (L.S of Ovule). 3.3. Development of megaspore and female gametophyte.	**02**
4	**Pollination** 4.1. Definition. 4.2. Types of pollination (Autogamy and Allogamy). 4.3. Contrivances in self and cross pollination. 4.4. Agencies of allogamy (Anemophily, Hydrophily, Entomophily, Ornithophily, Chiropterophily). 4.5. Advantages and Disadvantages of self and cross pollination.	**03**
5	**Fertilization** 5.1. Definition of Fertilization. 5.2. Types of Fertilization: Porogamy, Chalazogamy, Mesogamy. 5.3. Process of Double Fertilization.	**02**
6	**Seed** 6.1. Definition of Seed. 6.2. Structure of Seed. 6.3. Functions and Importance of Seed. 6.4. Difference between Seed and Grain. 6.5. Types of Seed: Based on Structure (Monocot and Dicot); Based on Life Span (Recalcitrant and Orthodox)	**02**
	CREDIT II - SEED TECHNOLOGY	**15**
7	**Introduction to Seed Technology** 7.1. Definition of Seed Technology. 7.2. History of Seed Technology in India. 7.3. Scope and Importance of Seed Technology.	**02**
8	**Government Organizations and Seed Industries in India** 8.1. International Seed Testing Association (ISTA). 8.2. National Seed Corporation (NSC). 8.3. State Seed Corporation (SSC).	**02**

	8.4. Central Seed Committee (CSC). 8.5. Central Seed Certification Board (CSCB). 8.6. Seed Certification Agency (SCA). 8.7. Seed Testing Laboratory (STL). 8.8. Seed Industries in India (Any 10 Industries).	
9	**Plant Introduction and Acclimatization** 9.1. Definition. 9.2. Types (Primary and Secondary). 9.3. Merits and Demerits. 9.4. Important achievements.	**02**
10	**Selection in relation to Crop Variety Improvement** 10.1. Definition. 10.2. Types of selection methods. 10.3. Mass Selection. 10.4. Pure line Selection. 10.5. Clonal Selection.	**02**
11	**Hybridization** 11.1. Definition and Objectives of hybridization. 11.2. Procedure for hybridization.	**03**
12	**Mutation for crop improvement** 12.1. Definition 12.2. Mutagens (Physical and Chemical), Mutants 12.3. Types of mutation (Point, Chromosomal, Spontaneous and Induced) 12.4. Limitations and Achievements of mutation breeding	**02**
13	**Components of Seed Technology** 13.1. Seed Production, Processing, Certification, Testing, Storage, Physiology, Entomology, Pathology and Marketing.	**02**

References:

1. Anonymous, 2009. Handbook of Agriculture. Indian Council of Agricultural Research, New Delhi.
2. Singh S. S., 2013. Handbook of Agricultural Sciences, Kalyani Publishers, New Delhi
3. Nitish Shekhar, 2012. Encyclopaedia of Entomology Vol.1, 2 and 3, Sonali Publications, New Delhi.
4. Anonymous, 2004. Seed Science and Technology: International Rules for Seed Testing. International Seed Testing Association, Switzerland
5. Rattan Lal Agarwal, 1999. Seed Technology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Vijaya Kumar A., V. Krishnasamy, P. Balamurugan, D. Kalavathi, K. Sivasubramaniam, P. Athimuthu, G. Selvaraj, H. Philip and C. Palanisamy, 2003. Quality Seed Production in Vegetables, Tamil Nadu Agricultural University, Coimbatore.
7. Sivasubramaniam K., P. Balamurugan, V. Krishnasamy, A. VijayaKumar, D. Kalavathi, , P. Athimuthu, G. Selvaraj, H. Philip and C. Palanisamy, 2003. Quality Seed Production in Pulses, Tamil Nadu Agricultural University, Coimbatore .

8. Krishnasamy V., P. Balamurugan, A. Vijaya Kumar, D. Kalavathi, K. Sivasubramaniam, P. Athimuthu, G. Selvaraj, H. Philip and C. Palanisamy, 2003. Quality Seed Production in Rice and Millets, Tamil Nadu Agricultural University, Coimbatore.
9. Kalavathi D., V. Krishnasamy, P. Balamurugan, A. VijayaKumar, K. Sivasubramaniam, P. Athimuthu, G. Selvaraj, H. Philip and C. Palanisamy, 2003. Quality Seed Production in Cotton, Tamil Nadu Agricultural University, Coimbatore.
10. P. Balamurugan, D. Kalavathi, V. Krishnasamy, A. VijayaKumar, K. Sivasubramaniam, P. Athimuthu, G. Selvaraj, H. Philip and C. Palanisamy, 2003. Quality Seed Production in Oil Seed Crops, Tamil Nadu Agricultural University, Coimbatore.
11. Brajesh Tiwari, 2010. Seed Production of Field Crops. Oxford Book Company, New Delhi.
12. Anonymous, 1967. Seed Testing Manual. Indian Council of Agricultural Research and United States Agency for International Development.
13. Majumdar D. K., 2011. Pulse Crop Production-Principles and Technologies, PHI Learning Private Limited, New Delhi.
14. Verma O. P., 2015, Seed Production Techniques of Major Crops. Daya Publishing House, New Delhi.
15. Khedar O. P., R. V. Singh, Y. K. Sinsinwar and VedPrakash, 2013. Seed Production Technology in Field Crops. Pointer Publishers, Jaipur.
16. Prabhakar Singh and B. S. Asati, 2015. Seed Production Technology of Vegetables. Daya Publishing House, New Delhi.
17. Das D. K., 2015, Seed Technology and Hybrid Seed Production. Astha Publishers and Distributers, New Delhi.
18. Sharma Archana, O. P. Chaubey and Ram Prakash, 2014. Seed Technology and Seed Pathology. Pointer Publishers, Jaipur.
19. Dahiya B. S. and K. N. Rai, 1998. Seed Technology. Kalyani Publishers, New Delhi.
20. Anonymous, 2000. Advances in Hybrid Seed Production Technology.
21. Padmavathi S., M. Prakash, S. Ezhil Kumar, G. Sathiyanarayanan, A. Kamaraj, 2012. A Text Book of Seed Science and Technology. New India Publishing Agency, New Delhi.
22. Tiwari Brijesh, 2014. Seed Production and Quality Control. Oxford Book Company, New Delhi.
23. Khedar O. P., R. V. Singh and S. S. Punia, 2013. Basics of Quality Seed Production, Pointer Publishers, Jaipur.
24. TiwariBrijesh, 2014. Seed Science and Technology. Oxford Book Company, New Delhi.
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F. Y. B. Sc. Botany [Semester - II]
Course Category – Minor Core Course (MN)
Course Code - BOT 192 MN
Course Title: Crop Science

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Crop Science** 1.1. Introduction, Definition. 1.2. Scope and Importance of crop science.	**02**
2	**General Principles of Crop Production** 2.1. Environmental factors, Climate, Soil. 2.2. Seed treatment and sowing 2.3. Inter-cultural practices – land preparation, irrigation, nutrient management, weed management etc. 2.4. Plant protection measures. 2.5. Harvesting, Threshing and Storage.	**04**
3	**Fundamentals of Agronomy** 3.1. Introduction, Scope and Importance. 3.2. Agro-climatic zones of India and Maharashtra. 3.3. Tillage and tilth- Definition, objectives and types of tillage. 3.4. Soil testing- objectives, sampling, DPA test, Bray's modified test.	**06**
4	**Cropping Systems** 4.1. Crop sequences and systems with special emphasis on mixed and inter-cropping, Seeding and Planting calculations. 4.2. Efficient use of water in crop production.	**03**
	Credit II	
5	**Crop Production and Marketing Strategies** 5.1. Subsistence, constraints, Conventional and Organic Methods. 5.2. Farmer's Markets and community supported agriculture- CSA's. 5.3. Major Developments in Crop Production - Adaptation of advance Technology; Government Schemes and Conservation programs.	**05**
6	**Commercial Crop cultivation** Cultivation of Paddy, Finger millet, Cotton, wheat, Onion, with reference to: Seed selection, Soil and climate, field preparation, seed rate, spacing/planting, propagation, irrigation, manures and fertilisers, inter-cultivation, pest and disease management, harvesting, yield and storage.	**10**

References:

1. Yellamanda Reddy T. & Sankara Reddi G. H. 2010, Principles of Agronomy, Kalyani Publishers, Ludhiana.
2. Reddy S. R. 2000, Principles of Agronomy, Kalyani Publishers, Ludhiana.
3. Chandrasekharan B., Annadurai K., Somasundaram E.,2014, Text book of Agronomy, New age international (P) Limited Publishers, Delhi.17

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5. Panda, S. E. 2012, Modern Concepts and advanced principles in crop production. Agribios (India) Publishers, Jodhpur.
6. Das N. R. 2009, Practical Manual on Basic Agronomy (with theory) scientific publishers (India), Jodhpur.
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F.Y. B. Sc. Botany
Semester – II

Vertical – 3 (V3)			
Generic Elective (GE) / Open Elective (OE) - (1T + 1P = 4C) (Any one from basket)	OE 151 BOT	Mushroom technology	**2 C**
	OE 152 BOT	Entrepreneurship & Business management in Plant Sciences	
	OE 153 BOT	Applications of Pollen Diversity in Bee Keeping	
	OEP 154 BOT	Practical Based on OE-151-BOT	**2 C**
	OEP 155 BOT	Practical Based on OE-152-BOT	
	OEP 156 BOT	Practical Based on OE-153-BOT	

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

Course Category – Generic Elective / Open Elective (OE)

Course Code –OE 151 BOT

Course Title: Mushroom Technology

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Mushroom** 1.1. History and Scope of Mushroom Cultivation, 1.2. Vegetative characters of edible and poisonous mushrooms.	**01**
2	**Nutritional and Medicinal Importance of Mushrooms** 2.1. Nutrient composition of Button, Oyster and Paddy Straw Mushrooms. 2.2. Comparative Nutritional Values – Vegetables and mushrooms. 2.3. Importance of mushrooms – Nutritional, Medicinal and Others.	**03**
3	**Morphology of Mushroom** 3.1. Button mushroom. 3.2. Oyster mushroom. 3.3. Paddy Straw Mushroom.	**02**
4	**Spawn of Mushroom (Seeds)** 4.1. Spawning Methods. 4.2. Spawn Types - Grain Spawn, Substrate Spawns. 4.3. Techniques of Spawn Production. 4.4. Storage of Spawn and Transport.	**03**
5	**Cultivation of Oyster Mushroom** 5.1. Pre –Requisite for cultivation -Substrate, Climate etc. 5.2. Bed Preparation-Types, Sterilization of Substrate material, inoculation. 5.3. Crop Management and Harvesting. 5.4. Packing and Storage.	**06**
	Credit II	**15**
6	**Diseases and Pests Management** 6.1. Disease - Control measures. 6.2. Pests-Major insect pests/ flies etc.	**03**
7	**Mushroom Preservation and Processing** 7.1. General methods of Mushroom preservation and processing.	**03**
8	**Value addition of Mushroom** 8.1. General requirement and composition for mushroom recipes - Mushroom pulao, Mushroom curry, Mushroom soup, Mushroom Pakora, etc.	**04**
9	**Mushroom Products** 9.1. Fresh Mushroom products. 9.2. Processed mushroom products.	**02**
10	**Marketing of Mushrooms** 10.1. Grading, 10.2. Marketing Channels. 10.3. Time of Sale. 10.4. Packing and Transport 10.5. Project Proposal Preparation	**03**

References:

1. Pandey, R.K. and Ghosh, S.K. (1996). A handbook of Mushroom Cultivation. Emkey Publication.
2. Pathak, V.N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur
3. Nita, B. (2000). Handbook of Mushrooms. Vol 1 & 2. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Tewari, P. and Kapoor S.C. (1998). Mushroom Cultivation, Mittal Publication, New Delhi.
5. Ashok Agarwal,Yashpal Sharma,Esha Jangra (2022)- A Text Book on Mushroom Cultivation Theoty and Practices

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

Course Category – Generic Elective / Open Elective (OE)

Course Code –OE 152 BOT

Course Title: Entrepreneurship and Business Management in Plant Sciences

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

Sr. No.	Topic Details	No. of Lectures
	Credit I - Entrepreneurship Development	**15**
1	**Entrepreneur & Entrepreneurship** 1.1. Entrepreneur- Concept, meaning, definition, entrepreneurial characteristic, Difference between entrepreneur and manager, role of entrepreneurs in economic growth, Types of entrepreneurs (according to Clarence Danhof). 1.2. Entrepreneurship- Concept, meaning, definition, factors responsible for entrepreneurship, Difference between entrepreneur and entrepreneurship. 1.3. Agri-entrepreneurship - definition, importance of agri - entrepreneurship development.	**05**
2	**Organizations/ institutions for entrepreneurship development** 2.1. Overview of entrepreneurship institutions: National Institute for Entrepreneurship and Small Business Development (NIESBUD), Entrepreneurship Development Institute of India (EDII), Indian Institute of Entrepreneurship (IIE), Small Industries Development Organizations (SIDO), National Institute for Micro, Small and Medium Enterprises (NIMSME), Small Industries Development Bank of India (SIDBI), National Entrepreneurship Development Board (NEDB).	**05**
3	**Government schemes and incentives for promotion of entrepreneurship development** Overview of Government policy for entrepreneurship development: (i) Prime Minister's Employment Generation Programme (PMEGP) (ii) Market Development Assistance Scheme for Micro/ Small Manufacturing Enterprises/ Small & Micro Exporters (iii) Rajiv Gandhi Udyami Mitra Yojana - A Scheme of "Promotion and Handholding of Micro and Small Enterprises" (iv) Credit Link Capital Subsidy Scheme for Technology Upgradation (v) Credit Guarantee Fund Scheme for Micro and Small Enterprises (vi) Schemes for Women Entrepreneurs: a) Mahila Udyami Yojana (MUY); b) SBI Stree Sakthi Package; c) Priya Darshini Yojana (Objective, Nature of Assistance ,Target group and Eligibility is expected)	**05**
	Credit II - Business Management	**15**
4	**Introduction to Management** 4.1. Meaning and importance of management, Functions of management 4.2. Management as Arts, Science, Profession and social system 4.3. Contribution of F W Taylor, Henry Fayol, Peter Drucker in development of management thoughts 4.4. Types of Business Entity- Sole traders, Partnership firm, Limited liability partnership, Joint ventures, Co-operative societies, Joint stock companies.	**05**

5	**Understanding Management** 5.1. Planning – meaning definition and nature of planning, types of planning, steps in planning, Limitations of planning, 5.2. Forecasting – meaning and definition of forecasting, techniques of forecasting 5.3. Decision Making- meaning types and steps in decision making 5.4. Staffing – Meaning, need and importance Recruitment 5.5. Concept of Authority and responsibility 5.6. Delegation of authority	**05**
6	**Businesses based on Plant Sciences** 6.1. Overview of- Transgenic plant production and industry, Molecular farming, Nursery and propagation industry, Tissue culture-Commercial propagation, Mushroom production, Medicinal plants and products production, Biofertilizer production, Biopesticides production, Ayurvedic formulations and production, herbal Cosmetics, Floriculture industry, Horticulture, Landscaping and gardening, Plant Health clinics and Plant disease diagnosis centres, Variety and seed development industry, Scientific tourism, Analytical services- soil, water, milk, tissue testing. **(Enlist only with brief Introductions)**	**05**

References-

1. Khanka, S. S. (1999). Entrepreneurship development. Ram Nagar, New Delhi, S. Chand & company limited.
2. Mondal, S., Ray, G.L. (2009). Textbook of Entrepreneurship Rural Development New Delhi, India, Kalyani Publishers.
3. Weihrich, H., Cannice, M.V., Knotz, H. (2008). Management: A Global and Entrepreneurial Perspective [Twelfth Edition]. New Delhi, Tata McGraw-Hill Publishing Company limited.
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14. Poongothai, K. (2006). Organisations for entrepreneurship development. Retrieved from https://shodhganga.inflibnet.ac.in/bitstream/10603/23213/9/09_chapter%202.p df
15. Shukla, M.B. (2016.) Entrepreneurship and Small Business Management. Kitab Mahal.
16. Upadhyay, D.K. (2015). National Entrepreneurship Development Board (NEDB).
17. Entrepreneurship Development and Business Communication Department of Extension Education Jawaharlal Nehru Krishi Vishwa Vidyalaya Krishi Nagar, Adhartal, Jabalpur-482004 (M.P.)
18. Innovation and Entrepreneurship in Biotechnology – An International Perspective Concepts, Theories and Cases Damian Hine (Senior Lecturer, University of Queensland, Australia) John Kapeleris (Deputy CEO, Australian Institute for Commercialisation, Brisbane, Australia) 2006
19. The Business of Biosciences – What makes a biotech entrepreneur? Springer http://www.springer.com/978-1-4419-0063-0 2009
20. Building a conducive environment for life science–based entrepreneurship and industry clusters Mark J. Ahn and Michael Meeks, Journal of Commercial Biotechnology. Vol 14. No 1. 20–30 January 2008
21. Critical success factors for biotechnology industry in Canada Sandra Vanderbyl and Sherry Kobelak, Journal of Commercial Biotechnology. Vol 13. No 2. 68–77 February 2007
22. Report of the Expert Committee on Innovation and Entrepreneurship NITI Aayog, New Delhi, August 2015
23. Fuelling Entrepreneurship – The Story of Technology Business Incubation In India National Science and Technology Entrepreneurship Development Board (Nstedb)
24. India is the nesting ground for young entrepreneurs and new start-ups Nikita Agarwal International Journal of Applied Research 2015; 1(7): 578-582
25. National Biotechnology Development Strategy – Promoting bioscience research, education and entrepreneurship Department of Biotechnology, Ministry of Science & Technology, Government of India, 2015
26. Good Incubation In India – Strategies for supporting social enterprise in challenging contexts Madeleine Gabriel, Florence Engasser and Kirsten Bound, January 2016
27. Entrepreneurship A study by National Knowledge Commission, 2008
28. Startup India Action Plan https://www.startupindia.gov.in/actionplan.php Biotech Consortium India Limited Page 191
29. The Entrepreneurship Guide to a Biotech Startup Peter Kolchinsky, 2001
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31. Department of Industrial Policy & Promotion http://dipp.nic.in/#
32. BioSpectrum Asia Edition https://www.biospectrumasia.com/
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F.Y.B.Sc. Botany [Semester-II]

Course Category – Generic Elective / Open Elective (OE)

Course Code –OE 153 BOT

Course Title: Applications of Pollen Diversity in Bee Keeping

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

Sr. No.	Topic Details	No. of Lectures
	CREDIT I	**15**
1	**Introduction to apiculture** 1.1. Definition. 1.2. Types of Honey bees and their characteristics. 1.3. Components and life stages of honeybee colony. 1.4. Equipment's of beekeeping and requirements to start beekeeping. 1.5. Products from Beekeeping and Diseases/ enemies of bees.	**04**
2	**Evolutionary relationship between angiosperms and honeybees** 2.1. Evolution of flower. 2.2. Insect Flower Visitors and the Significance of Bees. 2.3. Pollination in Gymnosperm Vs Angiosperm.	**02**
3	**Importance of the honeybees in Agriculture and Biodiversity** 3.1. Type of crops depends on bees for pollination 3.2. Effect of Bee Pollination on the Economy and Biodiversity 3.3. Effect of the bee pollination in productivity of the Agricultural crops (% of productivity increase in Agricultural crops)	**04**
4	**Factors affecting visit of honeybees to flower** 4.1. Color of the flowers. 4.2. Motion of flowers. 4.3. Quantity and/or quality of pollen and nectar. 4.4. Day Light. 4.5. Climate change. 4.6. Pesticides use. 4.7. Habitat loss.	**02**
5	**Structure, Physiology, Pollination and Fertilization in the flowering plants** 5.1. Structure of a typical flower 5.2. Photoperiodism and Vernalisation, Difference between Photoperiodism and Vernalisation 5.3. Pollination, Process of pollination, Self and Cross Pollination, Types of Cross Pollination (Anemophily, Zoophily, Hydrophily, Anthropophily) 5.4. Advantages and Disadvantages Of Cross-pollination	**03**
	CREDIT II	
6	**Pollen and its Importance** 6.1. Pollen and its typical structure. 6.2. Nutritional/Chemical composition of the pollen. 6.3. Processing of Pollen by honeybees. 6.4. Importance of pollen to bees and human – Pollen as a food, medicine, supplement, allergen.	**05**
7	**Honey and Nectar** 7.1. Difference between Honey and Nectar. 7.2. Unifloral and Multifloral Honey.	**03**

	7.3. List and information of nectar and pollen producing plants worked by the honey bee in India.	
8	**Honey pollen analyses** 8.1. Orientational screening 8.2. Leading pollen analysis 8.3. Full analysis 8.4. Scope of Palynology, Melissopalynology. Source of pollen in Honey and type of examination - Primary dusting, Secondary dusting, Tertiary dusting 8.5. Techniques used in the pollen analysis of honey - Pollen collection and processing; Dilution, Centrifugation and light microscope study; Pollen trap, Drying and Cleaning	**05**
9	9.1. Agricultural and horticultural crops worked by the honey bee in India. 9.2. Floral Calendar of Nearby Districts and Maharashtra.	**02**

References:

1. Directorate of forest-based Industry, Khadi and Village Industries Commissions Central Bee Research and Training Institute. Technical Bulletins. Mumbai, February 2008.
2. D. M. Wakhle and K. D. Kamble. Technology and Value addition of honey. Pune, Central Bee Research and Training Institute, April, 2001.
3. R. P. Phadake. Indian Honeybee and Beekeeping. Pune, Kirti Phadake, May, 2016.
4. Good beekeeping practices for sustainable apiculture FAO Animal Production and Health Guidelines No. 25. Rome. https://doi.org/10.4060/cb5353en
5. Clarence H. Colliso. Beekeeping Basics: MAAREC: Delaware, Maryland, New Jersey, Pennsylvania, West Virginia, and the USDA Cooperating…

F.Y.B.Sc. Botany [Semester-II]
Course Category – Generic Elective / Open Elective (OE)
Course Code –OEP 154 BOT
Course Title: Practical Based on OE 151 BOT

[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 –OEP 155 BOT
Course Title: Practical Based on OE 152 BOT

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

Sr. No.	Practical	No, of Practical
1	Study of Recent Government policies for the Entrepreneurship development	1 P
2	Preparation of the survey report on the Beneficiaries of the Government schemes and incentives for promotion of entrepreneurship development from the Area	2 P
3	Preparation of the Project Report on Start up for Plant Based Agro-industry (Business Enterprise) for the Approval to the Government /Non-Government organization.	2 P
4	Development of the Ecosystem for the any one plant based business	2 P
5	Case study of the five Entrepreneurs of the Agri-Based /Plant based Industries	2 P
6	Study of the Marketing and E-COMMERCE Tools for the Plant based products	1 P
7	Study of the different Funding Opportunities & Incentives under Government/Non-Government organizations.	1 P
8	Study of the different Entrepreneurships (businesses) based on Plant Sciences	1 P
9	Visit to the Plant based Industries/ Incubation Centre / Government /Non-Government organization involved in Entrepreneurship development and Business management	3 P

Note: 1. The Institution can opt for any 12 Practical's from above List +3 Practical's for Assessment and Evaluation of the students
2. While conducting the practical's emphasis should be given to preparation and Submission of Project report on startup/ Survey report / Visit Report.

F.Y.B.Sc. Botany [Semester-II]
Course Category – Generic Elective / Open Elective (OE)
Course Code –OEP 156 BOT
Course Title: Practical Based on OE 153 BOT

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

Sr. No.	Practical	No, of Practical
1	To visit botanical garden and enlist the flowering plants.	1 P
2	To survey different types of honey bee colonies in the college campus and create the geo-tagging photo album.	1 P
3	To study anatomical structure of honeybees and importance of pollen basket.	1 P
4	To study equipment used for pollen collection in beekeeping.	1 P
5	To estimate the protein concentration in the pollen grain by Lowry's method.	1 P
6	To observe pollen grains under microscope.	1 P
7	Awareness rally in any one village regarding importance of Honeybees.	1 P
8	To visit the local commercial apiary.	1 P
9	Collection and submission of natural honey, market honey and local beekeeper honey samples.	1 P
10	To observation collected honey samples under microscope, identification of the pollen morphology and plant source.	1 P
11	To collect commercial pollens from market and observe under microscope for identification of morphology and plant source.	1 P
12	To prepare pollen calendar for the 10 km radius agricultural and horticultural crops through survey.	1 P

F.Y. B. Sc. Botany

Semester – II

Vertical – 4 (V4)			
Vocational Skill Courses (VSC) – (1T = 2C) (Any one from basket)	BOT 171 VSC	Fruit Processing & Dehydration Technology	**2 C**
	BOT 172 VSC	Organic Farming	
	BOT 173 VSC	Biofertilizer Production Technology	
Skill Enhancement Courses (SEC) – (1T / 1P = 2C) (Any one from basket)	SECP 151 BOT	Plant Preservation Techniques	**2 C**
	SECP 152 BOT	Computer Literacy & Basics of MS Office	
	SECP 153 BOT	Plant Propagation Techniques	

F.Y.B.Sc. Botany [Semester-II]
Course Category –Vocational Skill Courses (VSC)
Course Code –BOT 171 VSC
Course Title: Fruit Processing and Dehydration Technology

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1.	**Fruit and Vegetables** 1.1. Introduction to fruits and vegetables 1.2. Importance of Fruits and Vegetables 1.3. Need of Fruit and Vegetable Preservation 1.4 History of Fruit and Vegetable Preservation 1.5 Objectives of Fruit and Vegetable Processing/Preservation 1.6 Status of Fruit and Vegetable Processing Industry in India	**03**
2.	**Nutritive Aspects of Fruits and Vegetables** 2.1 Carbohydrates 2.2 Proteins 2.3 Fats 2.4 Minerals 2.5 Organic Acids 2.6 Vitamins 2.7 Enzymes	**03**
3.	**Maturity Indices for Fruit and Vegetables** 3.1 Introduction to maturity index 3.2 Parameters of Maturity Index 3.2.1 Skin Colour 3.2.2 Optical methods 3.2.3 Shape 3.2.4 Size 3.2.5 Aroma 3.2.6 Fruit Opening 3.2.7 Leaf Changes 3.2.8 Abscission 3.2.9 Firmness 3.2.10 Moisture Content 3.2.11 Acidity	**02**
4.	**Post Harvest Handling Technology for Fruits and Vegetables** 4.1 Tools for Harvesting of Fruits and Vegetables 4.2 Materials for Packaging of Fruits and Vegetables in Fields 4.2.1 Polyethylene Bags 4.2.2 Plastic Field Boxes 4.2.3 Wooden Field Boxes 4.3 Spoilage of Fruits and Vegetables 4.3.1 Definition	**04**

	4.3.2 Types of Spoilage 4.3.2.1 Physical 4.3.2.2 Action of Enzyme 4.3.2.3 Chemical 4.3.2.4 Contamination-Microorganisms: Bacteria, Molds, Yeast	
5.	**Preservation of Fruits and Vegetables** 5.1 Introduction to preservation 5.2 Principles of Preservation 5.2.1 Prevention or delay of the microbial decomposition of the food. 5.2.2 Prevention or delay of the self-decomposition of the food. 5.2.3 Prevention or damage by insects, animals, or mechanical causes 5.3 Methods of Preservation: Preservation by low and high temperature, Filtration, Chemical, Food Additives, Oil, Fermentation, Carbonation, Antibiotics, Irradiation, Drying and Dehydration (Sun Drying, Mechanical Drying and Vacuum Drying)	**03**
	CREDIT-II	
6.	**Processing of Fruit and Vegetables** 6.1 Introduction to processing of Fruits and Vegetables 6.2 Equipment's used in processing 6.3 Canning and Bottling of Fruits and Vegetables	**02**
7.	**Preparation of Unfermented Beverages** 7.1 Introduction to Unfermented beverages 7.2 Fruit Juice 7.3 Fruit Pulp 7.4 Ready to Serve (RTS) 7.5 Squash 7.6 Syrup 7.7 Crush	**02**
8.	**Preparation of fermented Beverages** 8.1 Introduction to fermented beverages 8.2 Wine 8.3 Feni 8.4 Cider 8.5 Vinegar	**02**
9.	**Preparation of Jam, Jelly and Marmalade** 9.1 Introduction to Jam, Jelly and Marmalade 9.2 Procedure for Jam, Jelly and Marmalade production 9.3 Problems in Jam, Jelly and Marmalade production 9.4 Storage of Jam, Jelly and Marmalade	**03**
10.	**Preparation of Tomato Ketchup, Chutney, Puree/Paste** 10.1 Introduction to Ketchup, Chutney, Puree/Paste 10.2 Procedure in making of Ketchup Chutney, Puree/Paste	**02**

	10.3 Storage of Ketchup, Chutney, Puree/Paste	
11.	**Dehydration techniques and preparation of** 11.1 Potato Chips 11.2 Onion Powder 11.3 Beet Root Powder 11.4 Carrot 11.5 Bitter Gourd 11.6 Fenugreek Foliage 11.7 Chickpea Foliage 11.8 Storage of dehydrated products	**02**
12.	**Preparation of Pickles** 12.1 Introduction to pickles 12.2 Procedure in preparation of Raw Mango, Carrot, Lemon, Chilli pickles 12.3 Problems in pickle making 12.4 Storage of pickles	**02**

References:

- Fruit and Vegetable Preservation, R. P. Srivastava and Sanjeev Kumar
- Guidelines for Small Scale Fruit and Vegetables Processing- Peter Fellows
- Industrial Processing of Fruits and Vegetables-U D & J V Patil Chavan
- Post Harvest Handling and Processing of Fruits and Vegetables-I S Singh, Vinod Singh

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

Course Category - Vocation Skill Courses (VSC)

Course Code - BOT 172 VSC

Course Title: Organic Farming

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Organic farming** 1.1. Introduction, concept and definition. 1.2. Scope and Importance of Organic farming. 1.3. Concept of eco-farming systems	**03**
2	**Crop Planning and management** 2.1. Introduction, Crop rotation. 2.2. Inter-cropping system, cover crop. 2.3. Crop-animal associations. 2.4. Mulching –Definition, uses, sources and Application. 2.5. Integrated Pest Management (IPM)	**04**
3	**Sources of organic nutrients** 3.1. Organic nutrient sources and their fortification. 3.2. Organic manures - methods of compositing, vermicomposting, green manures, bio-fertilizer-types, methods of application, benefits & Limitation.	**04**
4	**Soil** 4.1. Definition, Composition of Soil- Soil texture and Types, Soil structure, Soil Profile, Humus & Soil pH 4.2. Role of Soil in Organic Farming 4.3. Soil factors affecting plant Growth: light, heat, water, humidity, pH and Nutrition 4.4. C: N ratio of good fertile Soil	**04**
	Credit II	**15**
5	**Farms of organic management** 5.1. Biodynamic agriculture. 5.2. Rishi Krishi Natural farming. 5.3. Panchgavya Krishi Natural farming. 5.4. Homia farming.	**04**
6	**Organic Field management** 6.1. Land preparation - Tools and Technique 6.2. Preparation of seed bed , manuring, sowing, watering and raising of seedling	**04**
7	**Weed management** 7.1. Weeds - characteristics of weeds, merits and demerits of weeds. 7.2. Classification of weeds 7.3. Principles and methods of weed management viz., cultural, mechanical, chemical, biological weed control methods and integrated weed management.	**04**

8	**Organic Farming Certification** 8.1. Introduction, importance of certification. 8.2. Process - Inspection, Certification, Labelling and Accreditation procedures of organic products processing. 8.3. Economic consideration and viability.	**03**

References:

1. Principles of Organic Farming by S. R. Reddy, Kayani Publishers, New Delhi.
2. Organic Farming (Theory and Practice) by S. P. Palaniappan and Annadurai, Scientific Publishers, New Delhi.
3. www.nptel.ac.in – Organic Farming – 126/105/126105014
4. http://www.agmoocs.in/organic farming

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

Course Category - Vocation Skill Courses (VSC)

Course Code - BOT 173 VSC

Course Title: Biofertilizer Production Technology

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

Sr. No.	Topic Details	No. of Lectures
	Credit I	**15**
1	**Biofertilizers** 1.1. Introduction and Definition. 1.2. Scope and Importance of Biofertilizers. 1.3. Importance of Biofertilizers in Organic Farming. 1.4. Classification of Biofertilizers.	**03**
2	**Nitrogen rich Biofertilizer** 2.1. Introduction, role of N as essential nutrient for plants. 2.2. Nitrogen cycle. 2.3. Biological nitrogen fixation by *Rhizobium,* isolation and mass production of *Rhizobium* biofertilizer. 2.4. Isolation and mass production of non-symbiotic nitrogen fixing bacterial biofertilizers.	**06**
3	**Phosphorous rich Biofertilizer** 3.1. Introduction, role of P as essential nutrient for plants. 3.2. Isolation of Phosphate solubilizing bacterial biofertilizer. 3.3. Mechanism of P solubilization.	**03**
4	**Algal Biofertilizer** 4.1. Introduction, importance of algae as biofertilizer 4.2. Types of algal biofertilizers. 4.3. Isolation, culture, identification and mechanism of Nitrogen fixing algae. 4.4. Role of seaweed algae as biofertilizers.	**03**
	Credit II	**15**
5	**Symbiotically associated microbes: Arbuscular mycorrhizae** 5.1. Introduction, concept of mycorrhiza. 5.2. Types of mycorrhizae and their beneficial role. 5.3. Isolation, identification, culture and mass cultivation of AM fungi. 5.4. Quality control and its applications.	**05**
6	**Fungi as biocontrol agents** 6.1. Introduction, definition concept of biopesticides. 6.2. Types of fungi used as biocontrol agent. 6.3. Isolation, identification, culture and mass cultivation of *Trichoderma, Beauveria, Paecilomyces, Metarhizium*.	**05**
7	**Biofertilizer Applications** 7.1. Application technology of Biofertilizer for seeds, seedlings, tubers, sets etc. 7.2. Biofertilizers -Storage, shelf, Quality Control and certification procedures of Organic products.	**05**

References:

1. Arun K. Sharma. 2002. A Hand book of organic farming. Agrobios, India. 627p.
2. Dongarjal R.P. and Zade S.B(2019) Insect Ecology and Integrated Pest Management Akinik Publications , New Delhi.
3. Tiwari, V.N., Gupta, D.K., Maloo, S.R and Somani, L.L. 2010. Natural, organic, biological, ecological and biodynamic farming. Agrotech Publishing Academy, Udaipur, 420p.
4. Kumaresan, V. (2005). Biotechnology. New Delhi, Delhi: Saras Publication.
5. Sathe, T.V. (2004). Vermiculture and Organic Farming. New Delhi, Delhi: Daya publishers.
6. Subha Rao, N.S. (2000). Soil Microbiology. New Delhi, Delhi: Oxford & IBH Publishers

F. Y. B. Sc. Botany [Semester - II]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SECP 151 BOT
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 – SECP 152 BOT
Course Title: Computer Literacy and Basics of MS Office
[No. of Credits: 2 C] **[No. of Lectures: 60 L]**

Sr. No.	Title of the Practical	No. of Practical
1	**Study of MS Office with reference to MS Word:**	**05 P**
A	MS Word: Working with Documents -Opening & Saving files, editing text documents, Inserting, Deleting, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace, Formatting page & setting Margins, converting files to different formats, Importing & Exporting documents, sending files to others, Using Tool bars, Ruler, Using Icons, using help.	
B	Formatting Documents - Setting Font styles, Font selection- style, size, Colour etc., Type face -Bold, Italic, Underline, Case settings, Highlighting, Special symbols, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering. Setting Page style - Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, inserting page break, Table of Contents, Index, Page Numbering, date & Time, Author etc., Creating Master Documents, Web page.	
C	Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting ClipArts, Pictures/Files etc., Tools – Word Completion, Spell Checks, Mail merge, Templates, creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature. Printing Documents – Shortcut keys.	
2	**Study of MS Office with reference to MS Excel:**	**05 P**
A	Getting to know Excel: Starting from the desktop, Understanding the start screen, The workbook screen, How excel works, Using the ribbon, Showing and collapsing the ribbon, Understanding the backstage view, Accessing the backstage view Using shortcut menus, Understanding dialog boxes, Launching dialog boxes, Understanding the quick access toolbar, Adding commands to the quick access toolbar Understanding the status bar, Exiting safely.	
B	Creating a new workbook: Understanding workbooks, Using the blank workbook template, Typing text, Typing numbers, Typing dates, Typing formulas, Easy formulas, Saving a new workbook on your computer, Checking the spelling, Making basic changes, Printing a worksheet, Safely closing a workbook.	
C	Working with workbooks: Opening an existing workbook, navigating a workbook, Navigating using the keyboard, using go to, Recent files and folders. Editing in a workbook: Understanding data editing, overwriting cell contents, editing longer cells, editing formulas, clearing cells, deleting data, Using undo and redo. Selecting ranges: Understanding cells and ranges, selecting contiguous ranges, selecting non-contiguous ranges, using special selection techniques, selecting larger ranges, selecting rows, Selecting columns. Copying data: Understanding copying, Using fill for quick copying, Copying from one cell to another, Copying from one cell to	

	a range, Copying from one range to another, Copying relative formulas, Copying to a non-contiguous range, Copying to another worksheet, Copying to another workbook.	
D	Formulas and functions: Understanding formulas, Creating formulas that add, Creating formulas that subtract, Formulas that multiply and divide, Understanding functions, Using the sum function, Summing non-contiguous ranges, Calculating an average, Finding a maximum value, Finding a minimum value, Creating more complex formulas, What if formulas, Common error messages. Font formatting: Understanding font formatting, Working with live preview, Changing fonts, Changing font size, Growing and shrinking fonts, Making cells bold, Italicizing text, Underlining text, Changing font colours, Changing background colours, Using the format painter, Applying strikethrough, Subscripting text, Superscripting text, Practice exercise. Cell alignment: Understanding cell alignment, Horizontal cell alignment, Vertical cell alignment, Rotating text, Indenting cells, Number formatting, Understanding number formatting, Applying general formatting, Formatting for money, Formatting percentages, Formatting as fractions, Formatting as dates, Using the thousands separator, Increasing and decreasing decimals. Row and column formatting: Approximating column widths, Setting precise columns widths, Setting the default column width, Approximating row height, Setting precise row heights.	
E	**Working with a worksheet:** Understanding worksheets, Changing the worksheet view, Worksheet zooming, Viewing the formula bar, Viewing worksheet gridlines, Viewing the ruler, Inserting cells into a worksheet, Deleting cells from a worksheet, Inserting columns into a worksheet, Inserting rows into a worksheet, Deleting rows and columns, More than one worksheet, Worksheet wisdom. **Sorting data:** Understanding lists, Performing an alphabetical sort, Performing a numerical sort, Sorting on more than one column, Sorting numbered lists, Sorting by rows. **Filtering data:** Understanding filtering, Applying and using a filter, Clearing a filter, Creating compound filters Multiple value filters, Creating custom filters, Using wildcards. **Printing:** Understanding printing, Previewing before you print, Selecting a printer, Printing a range, Printing an entire workbook, Specifying the number of copies, The print options. **Creating charts:** Understanding the charting process, Choosing the right chart, Using a recommended chart, Creating a new chart from scratch, Working with an embedded chart, Resizing a chart, Repositioning a chart, Printing an embedded chart, Creating a chart sheet, Changing the chart type, Changing the chart layout, Changing the chart style, Printing a chart sheet, Embedding a chart into a worksheet, Deleting a chart.	
3	**Study of MS Office with reference to MS PowerPoint:**	**05 P**
A	Getting to know PowerPoint: Starting PowerPoint, Understanding the start screen, Creating a new blank presentation, The PowerPoint screen, How microsoft powerpoint works, Using the ribbon, Using ribbon keytips, Showing and collapsing the ribbons, Understanding the backstage view, Accessing the backstage view, Using shortcut menus, Understanding dialog boxes, Launching dialog boxes, Understanding the quick access toolbar, Adding commands to the QAT, Understanding the status bar, Customising the status bar, Exiting safely from PowerPoint. First	

	presentation: Creating presentations in PowerPoint, Creating a presentation, Applying theme variants, The save as place, The save as dialog box, Typing text into a slide, Inserting new slides, Typing text using the outline pane, Applying slide transitions, Saving a presentation, Previewing a slide show, Closing a presentation.	
B	Working with presentations: The open place, The open dialog box, Opening a presentation, Opening multiple presentations, Switching between open presentations, Understanding presentation views, Changing presentation views, Navigating a presentation, Using the zoom tool, Opening a recent presentation. Working with text: Editing text, Checking spelling and grammar, Understanding font formatting, Applying font formatting, Applying paragraph formatting, Changing bullet and numbering styles, Moving and resizing placeholders, Applying wordart to text, Converting text to smartart. Slide layouts: Understanding slide layouts, Inserting a title slide, Inserting a title and content slide, Inserting a section header slide, Inserting a table, Inserting a picture with caption slide, Inserting a chart, Changing the slide layout. SmartArt: Understanding smartart, Inserting a smartart graphic, Inserting text into smartart, Adding shapes below, Adding shapes above, Adding shapes before and after, Adding an assistant, Promoting and demoting shapes, Switching smartart right to left, Resizing smartart, Changing the smartart layout, Applying a colour scheme, Applying a smartart style, Deleting smartart shapes. Shapes: Drawing shapes, Resizing shapes, Editing shapes, Positioning shapes, Arranging shapes, Merging shapes, Formatting shapes, Using the eyedropper, Copying shapes, Aligning shapes using the ribbon, Aligning objects using the smart guides, Inserting and formatting text, Connecting shapes, Grouping shapes, Rotating shapes.	
C	Preparing for presentations: Using slide sorter view, Reusing slides, Adding sections, Adding notes to your slides, Slide numbers, About hyperlinks, Creating an internal hyperlink, Creating a hyperlink to another presentation, Creating a hyperlink to another application, Keyboard shortcuts for navigating slide shows, Using resume reading, Presenting a slide show. Printing the presentation: Understanding printing, Previewing slides, Printing slides, Printing handouts, Printing notes pages, Printing the outline.	
D	Themes: Understanding themes, Applying a theme, Changing the theme colours, Creating custom theme colours, Changing the theme fonts, Changing the slide background, Saving a customised theme, Using a customised theme, Deleting a customised theme. Slide masters: Understanding slide masters, Viewing the slide master, Changing the master font, Modifying bullets, Inserting an image, Applying slide transitions to the slide master, Inserting slide numbers, Creating custom slide layouts, Modifying slide layouts. Templates: Understanding templates, Setting a custom templates location, Using an existing template, Creating a template from a template, Saving a custom template, Creating a template from a theme, Modifying a template, Using a custom template. Tables: Inserting a table using the ribbon, Inserting rows and columns, Applying a table style, Merging and splitting cells, Adjusting column widths, Adjusting row heights, Resizing and positioning a table, Formatting table data, Aligning table data, Applying borders, Applying shading. Charts: Understanding charts, Inserting a chart using the ribbon, Changing the chart type, Chart elements, Using quick layouts,	

	Understanding chart buttons, Changing the layout of chart elements, Applying a chart style, Understanding the chart format panes, Formatting chart elements, Editing a data series, Hiding data series, Working with pie charts.	
E	Images: Understanding clip art and pictures, Inserting a picture from file, Inserting an online picture, Resizing an image, Positioning an image, Inserting clip art, Modifying graphics, Rotating and flipping clip art, Inserting a screenshot, Inserting a screen clip, Creating a photo album. Enhancing images: Understanding picture enhancements, The format picture pane, Removing an image background, Applying colour corrections, Recolouring an image, Applying a picture style, Applying picture effects, Applying artistic effects, Cropping an image. Media and action buttons: Understanding media in powerpoint, Inserting an online video, Inserting an online audio clip, Formatting media clips, Editing audio clips, Optimising and compressing media, Understanding action buttons, Inserting action buttons. Animations and transitions: Understanding animations and transitions, Animating text, Animating objects, Applying multiple effects, Applying motion paths, The animation pane, Setting the timing, Animating smartart graphics, Using slide transitions, Setting up the show, About self-running presentations, Recording a slide show, Setting up a self-running presentation, Rehearsing timings, Setting up a speaker-led show, Creating a custom show, Understanding presenter view, Using presenter view. Saving and sharing presentations: Packaging presentations for CD, Saving a presentation as a PDF document, Saving a presentation as a video, Sending a presentation via email, Presenting a slide show online, Saving to a storage device. Working collaboratively: Co-authoring documents, Saving to one drive, Sharing presentations, Opening shared presentations.	

F. Y. B. Sc. Botany [Semester - II]
Course Category – Skill Enhancement Course – Practical (SECP)
Course Code – SECP 153 BOT
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.	01 P
12	Demonstration of Terrace, Vertical, and Indoor Garden with the help of ICT tools.	01 P
13	Visit to crop/Ornamental /Forest nursery and submission of visit report.	01 P