

**KAVAYITRI BAHINABAI CHAUDHARI  
NORTH MAHARASHTRA UNIVERSITY, JALGAON**

॥अंतरी पेटवू ज्ञानज्योत॥



**Semester-wise Code structure and Syllabus for**

**Faculty: Science and Technology**

**B. Sc. (BOTANY)  
(Honors/Research) Programme**

**As per NEP2020 For Affiliated Colleges**

**With effect from 2024**

## Preamble

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon believes in implementing several measures to bring equity, efficiency and excellence in higher education system in conformity to the guidelines laid down by the University Grants Commission (UGC). In order to achieve these goals, all efforts are made to ensure high standards of education by implementing several steps to enhance the teaching-learning process, examination and evaluation techniques and ensuring the all-round development of students. F.Y.B. Sc. Botany has been designed to have a progressive and innovative curriculum in order to equip our students to face the future challenges in the field of higher education. The well-organized curricula including basic as well as advanced concepts in the plant sciences from first year to the third year shall inspire the students to pursue higher studies in Botany and become an entrepreneur and also enable students to get employed in the Botany subject-based industries. This course will help students to build on the basic information regarding classification of plant kingdom groups like algae, fungi, bryophytes, pteridophytes, gymnosperms & angiosperms. This course will also help students To be able to understand the physiology of plants & its importance & implications to human life National Education Policy (NEP – 2020) provides opportunities for internships with local industry, businesses, artists, crafts persons, etc., as well as research internships with faculty and researchers at their own or other HEIs/research institutions, so that students may inquiryly engage with the practical side of their learning and, as a by-product, further improve their employ-ability. It also recognizing, identifying, and fostering the unique capabilities of each student to promote her/his holistic development Objectives: The curriculum for the F.Y.B.Sc. Programme in Botany has been designed with an aim of encouraging the broad instructional goals and to support the growing demands and challenging trends in the educational scenario. It targets at providing an environment that encourages, promotes and stimulates the intellectual, professional and personal development of the student. The curriculum caters to the all-round development of the student, rolling out globally ready individuals into the fast-pacing world.

## Objectives

- 2.1. The objective of the Bachelor's program in Botany is to equip the students to gain conceptual and analytical skills about morphological, anatomical, physiological, biochemical and cellular aspects of lower and higher plants.
- 2.2. The program emphasizes to apply knowledge acquired about different taxa of plants for their manipulations, biomolecules and conservation.
- 2.3. The imparting of laboratory training for bioassay protocols of biological materials, their manipulative treatments, emerging tissue culture and genetic recombinant techniques.

The curriculum for the F.Y.B.Sc. Programme in Botany has been designed with an aim of encouraging the broad instructional goals and to support the growing demands and challenging trends in the educational scenario. It targets at providing an environment that encourages, promotes and stimulates the intellectual, professional and personal development of the student. The curriculum caters to the all-round development of the student, rolling out globally ready individuals into the fast-paced world

1. Know the importance and scope of the discipline.
2. Inculcate interest in and love of nature with its myriad living forms.
3. Impart knowledge of science as the basic objective of Education.
4. Create a scientific attitude to make students open minded, critical and curious.
5. Develop the ability to work hard and make students fit for society.
6. Expose students to the diversity amongst life forms.
7. Develop skill in practical work, experiments, equipment's and laboratory use along with collection and interpretation of biological materials and data.
8. Make them aware of natural resources and environment and the importance of conserving it.
9. Develop the ability for the application of acquired knowledge in various fields of life so as to make our country self-sufficient.
10. Appreciate and apply ethical principles to biological science research and studies

### Program outcomes

#### **PO 1. Knowledge and understanding of:**

1. The range of plant diversity in terms of structure, function and environmental relationships.
2. The evaluation of plant diversity.
3. Plant classification and the flora of Maharashtra.
4. The role of plants in the functioning of the global ecosystem.
5. A selection of more specialized, optional topics.
6. Statistics as applied to biological data.

#### **PO 2. Intellectual skills – able to:**

1. Think logically and organize tasks into a structured form.
2. Assimilate knowledge and ideas based on wide reading and through the internet.
3. Transfer of appropriate knowledge and methods from one topic to another within the subject.
4. Understand the evolving state of knowledge in a rapidly developing field.
5. Construct and test the hypothesis.
6. Plan, conduct and write a report on an independent term project.

**PO 3. Practical skills:** Students learn to carry out practical work, in the field and in the laboratory, with minimal risk. They gain introductory experience in applying each of the following skills and gain greater proficiency in a selection of them depending on their choice of optional modules.

1. Interpreting plant morphology and anatomy.
2. Plant identification.
3. Vegetation analysis techniques.
4. A range of physiochemical analyses of plant materials in the context of plant physiology and biochemistry.

5. Analyze data using appropriate statistical methods and computer packages.
6. Plant pathology to be added for sharing of field and lab data abstained.

**PO 4. Transferable skills:**

1. Use of IT (word-processing, use of internet, statistical packages and databases).
2. Communication of scientific ideas in writing and orally.
3. Ability to work as part of a team.
4. Ability to use library resources.
5. Time management.
6. Career planning.

**PO 5. Scientific Knowledge:** Apply the knowledge of basic science, life sciences and fundamental process of plants to study and analyze any plant form.

**PO 6. Problem analysis:** Identify the taxonomic position of plants, formulate the research literature, and analyze non reported plants with substantiated conclusions using first principles and methods of nomenclature and classification in Botany.

**PO 7. Design/development of solutions:** Design solutions from medicinal plants for health problems, disorders and disease of human beings and estimate the phytochemical content of plants which meet the specified needs to appropriate consideration for the public health.

**PO 8. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and development of the information to provide valid conclusions.

**PO 9. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern instruments and equipment for Biochemical estimation, Molecular Biology, Biotechnology, Plant Tissue culture experiments, cellular and physiological activities of plants with an understanding of the application and limitations.

**PO 10. The Botanist and society:** Apply reasoning informed by the contextual knowledge to assess plant diversity, its importance for society, health, safety, legal and environmental issues and the consequent responsibilities relevant to the biodiversity conservation practice.

**PO 11. Environment and sustainability:** Understand the impact of the plant diversity in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO 12. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO 13. Ethics:** Apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity conservation.

**PO 14. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO 15. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes

- PSO 1.** Understand the diversity, systematic, morphology, life cycle pattern and economic importance of Algae.
- PSO 2.** Understand the diversity, systematic, morphology, life cycle pattern and economic importance of Fungi.
- PSO 3.** Understand the diversity, systematic, morphology, life cycle pattern and economic importance of Bryophyta.
- PSO 4.** Understand the diversity, systematic, morphology, life cycle pattern and economic importance of Pteridophyta and Gymnosperm.
- PSO 5.** Understand the eukaryotic cell cycle and cell division in plants.
- PSO 6.** Study Structure and organization of cell membrane and Process of membrane transport and membrane models.
- PSO 7.** Explain Mendelian and Neo-mendelian genetics.
- PSO 8.** Understand importance and scope of plant physiology with respect to water relations, Photosynthesis and Respiration.
- PSO 9.** Understand plant communities and ecological adaptations in plants.
- PSO 10.** Know the concept of methodology in taxonomy.
- PSO 11.** Learn about conservation of biodiversity, Non-conventional Energy and Pollution.
- PSO 12.** Learn the scope and importance of molecular biology with emphasis on DNA and Protein synthesis.
- PSO 13.** Understand the role plants in human welfare and Gain knowledge about various plants of economic use
- PSO 14.** Get the detail knowledge about modern strategies applied in Plant Breeding for crop improvement and Genome analysis.

## Course Outcomes

1. The framework of the curriculum for the Bachelor's program in Botany aims to transform the course content and pedagogy to provide a multidisciplinary, student-centric, and outcome-based, holistic education to the next generation of students.
2. Aside from structuring the curriculum to be more in-depth, focused, and comprehensive with significant skill-set for all exit levels; keeping in mind the job prospects; the emphasis has been to maintain academic coherence and continuum throughout the program of study and help build a strong footing in the subject, thereby ensuring a seamless transition into their careers.
3. Special attention is given to eliminating redundancy, discouraging rote learning, and espousing a problem-solving, critical thinking, and inquisitive mindset among learners.
4. The curriculum embraces the philosophy that science is best learned through experiential learning, not limited to the confines of a classroom but rather through hands-on training, projects, field studies, industrial visits, and internships.
5. This updated syllabus, with modern technology, helps students stay informed on the leading edge developments in plant sciences and promotes curiosity, innovation, and a passion for research, that will serve them well in their journey into scientific adventure and discovery beyond graduation.
6. The goal is to equip students with holistic knowledge, competencies, professional skills, and a strong positive mindset that they can leverage while navigating the current stiff challenges of the job market

# Semester-wise Code structure For F. Y. B. Sc. Botany

## Programme As per NEP2020,

## For affiliated colleges w.e.f – June 2024.

### Abbreviations:

- **T:** Theory Course
- **DSC:** Discipline Specific Core Course
- **DSE:** Discipline Specific Elective Course
- **MIN:** Minor subject
- **VSC:** Vocational Skill Courses
- **GE/OE:** Generic/open elective
- **IKS:** Indian Knowledge System
- **CEP:** Community engagement and service
- **RP:** Research Project methodology
- **MIL:** Modern Indian language
- **VSEC:** Vocational skill and Skill enhancement courses
- **OJT:** On Job Training: Internship/ Apprenticeship
- **Co-curricular Course (CC)**
  - a) **CC-1: CC-120: Sports and Yoga**
  - b) **CC-2: CC-130: Cyber Security**
  - c) **CC-3: CC-220: Human Rights and Environment Law**
  - d) **CC-4: CC-229: Communication Skills and Personality Development**
- **Value Education Courses (VEC)**
  - a) **VEC1: ES-118: Environmental Science**
  - b) **VEC2: CI-129: Constitution of India**
- **Indian Knowledge System (IKS):** a) **IK: 119: Ayurvedic Medicine in Ancient India**
- **Ability Enhancement Courses (AEC)**
  - a) **AEC-1: EG: 101 – English -1**
  - b) **AEC-2: EG: 102 – English -2**
  - c) **AEC-3: MR: 201 – Marathi -1**
  - d) **AEC-3: HN: 201 – Hindi -1**
  - e) **AEC-3: MR: 202 – Marathi -2**
  - f) **AEC-3: HN: 202 – Hindi -2**
- **P:** Practical course
- **RM:** Research
- **ENG:** English
- **ES:** Environment studies
- **SEC:** Skill Enhancement courses
- **CI:** Constitution of India

**Semester-wise Code structure for B. Sc (Honors/Research) Programme as per NEP2020, for  
Affiliated Colleges w.e.f – June 2024.**

**B. Sc (Honors/Research) Botany – First Year, SEMESTER – I, Level – 4.5**

Course	Course Type	Course Code	Course Title		Credits Teaching Hours/ Week			Marks (Total 100)			
					T	P		Total Internal (CA)		External (UA)	
								T	P	T	P
DSC-1	DSC	BO-111	Diversity of Lower Cryptogames	2	2	--	2	20	--	30	--
DSC-2	DSC	BO-112	Morphology of Angiosperms	2	2	--	2	20	--	30	--
DSC-3	DSC	BO-113	Practical Based on BO 111 and BO 112	2	--	4	4	--	20	--	30
MIN-1	MIN	BO-114	Biofertilizers	2	2	--	2	20	--	30	--
MIN-2	MIN	BO-115	Practical Based on BO 114	2	--	4	4	--	20	--	30
OE-1	OE	BO-116	Plant Nursery Management	2	2	--	2	20	--	30	--
SEC-1	SEC	BO-117	Herbal Techniques	2	2	--	2	20	--	30	--
VEC-1	VEC	EA-118	Environmental Awareness	2	2	--	2	20	--	30	--
IKS	IKS	IK-119	Ayurveda Medicine in Ancient India	2	2	--	2	20	--	30	--
CC-1	CC	CC-120	Select any one from Following A) Sports B) Yoga	2	1	1	2	20	--	30	--
AEC-1	AEC	EG-101	English -1	2	2	--	2	20	--	30	--

**B. Sc (Honors/Research) Botany– First Year, SEMESTER – II, Level – 4.5**

<b>DSC-4</b>	<b>DSC</b>	<b>BO-121</b>	Diversity of Higher Cryptogames	2	2	--	2	20	--	30	--
<b>DSC-5</b>	<b>DSC</b>	<b>BO-122</b>	Plant Anatomy	2	2	--	2	20	--	30	--
<b>DSC-6</b>	<b>DSC</b>	<b>BO-123</b>	Practical Based on BO-121 and BO 122	2	--	4	4	--	20	--	30
<b>MIN-3</b>	<b>MIN</b>	<b>BO-124</b>	Mushroom Technology	2	2	--	2	20	--	30	--
<b>MIN-4</b>	<b>MIN</b>	<b>BO-125</b>	Practical Based on BO-124	2	--	4	4	--	20	--	30
<b>OE-2</b>	<b>OE</b>	<b>BO-126</b>	Food Technology	2	2	--	2	20	--	30	--
<b>SEC-2</b>	<b>SEC</b>	<b>BO-127</b>	Practical Based on BO-126	2	2	--	2	20	--	30	--
<b>SEC-3</b>	<b>SEC</b>	<b>BO-128</b>	Plant for Human Nutrition	2	--	4	4	--	20	--	30
<b>VEC-2</b>	<b>VEC</b>	<b>CI-129</b>	<b>Constitution of India</b>	2	2	--	2	20	--	30	--
<b>CC-2</b>	<b>CC</b>	<b>CC-130</b>	<b>Select any one from Following</b> A) NSS B) NCC	2	2	--	2	20	--	30	--
<b>AEC-2</b>	<b>AEC</b>	<b>EG-102</b>	<b>English -2</b>	2	2	--	2	20	--	30	--

**Cumulative Credits For First Year – 44**

\* Students need to complete one month on job training (**OJT**) or internship in any industry related to major subject.



**Course Code: BO-111**

**Course Title: Diversity of Lower Cryptogames**

<b>Course Code: BO-111</b>	<b>Course Category: Core Course (DSC)</b>
<b>Course Title: Diversity of Lower Cryptogames</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To study the diversity among microbes.</li><li>2. To study systematic, morphology and structure of Bacteria, Viruses, Algae and Fungi.</li><li>3. To study the life cycle pattern of Bacteria, Viruses, Algae and Fungi.</li><li>4. To study the useful and harmful activities of Bacteria, Viruses, Algae and Fungi.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. To Provide identification technique of microbes, Viruses, Bacteria, Algae and Fungi.</li><li>2. To Understand the systems of classification of Viruses, Bacteria, Algae and Fungi, and its interdisciplinary approaches.</li><li>3. To Provide lab-based training in writing short species descriptions and illustration.</li></ol> To Recognize members of the major Viruses, Bacteria, Algae, Fungi and their medicinal, economic importance for human welfare.	

## **Course Content:**

### **Unit 1: Diversity of Lower Cryptogams**

**(07 L, 50 M)**

#### 1.1 Introduction and definition

#### 1.2 Viruses

- i. Introduction, discovery and characteristics of Viruses
- ii. General morphology of viruses: Helical, Polyhedral, Enveloped and Complex viruses
- iii. Nature of viruses (living and non-living)
- iv. Ultra structure of viruses
- v. Reproduction of Bacteriophage: Lytic and Lysogenic cycle

- vi. Economic importance
- vii. Plant diseases caused by viruses w.r.t. causal organism, symptoms and control measures of
  - i. Yellow vein mosaic disease of Lady's finger
  - ii. Bunchy top of Banana

**Unit 2: Bacteria** **(07 L, 50 M)**

- 2.1 : Introduction, discovery and general characters
- 2.2 : Classification of Bacteria on the basis of morphology
- 2.3 : Ultrastructure of Bacterial Cell
- 2.4 : Gram positive and Gram-negative Bacteria
- 2.5 : Reproduction - Asexual and Sexual (Conjugation)
- 2.6 : Economic importance of Bacteria - useful and harmful activities
- 2.7 : Study of Bacterial diseases w.r.t. causal organism, symptoms and control
  - Measures of
    - i) Citrus canker
    - ii) Black arm of Cotton

**Unit 3: Algae:** **(08 L, 50 M)**

- 3.1 : Introduction, definition and general characters
- 3.2 : Habitats of algae: aquatic, terrestrial and unusual habitats.
- 3.3 : Thallus structure in algae
- 3.4 : Reproduction: vegetative, asexual and sexual
- 3.5 : Classification of algae according to G. M. Smith (1955) up to classes with reasons giving at least two examples from each class
- 3.6 : Economic importance of algae in Agriculture, Food, Industries and Medicine
- 3.7 : Study of life cycle of *Nostoc* w.r.t. Systematic position Occurrence, structure of colony and filament, ultrastructure of Nostoc cell and reproduction

**Unit 4: Fungi, Lichens and Mycorrhiza:** **(08 L, 50 M)**

- 4.1 : Introduction, definition and general characters
- 4.2 : Thallus structure, reproduction and mode of nutrition
- 4.3 : Classification of Fungi, according to G.M. Smith up to classes with reasons giving at least two examples of each class
- 4.4 : Economic importance of Fungi in Agriculture, Food, Industries and Medicine.
- 4.5 : Study of life cycle of *Aspergillus*. w. r. t. Systematic position, structure of mycelium and reproduction
- 4.6 a. **Lichens:** definition, characters, types and economics importance
- b. **Mycorrhiza:** Definition, general account, significance and types

## Reference Books:

1. Agrawal, S. B. and Srivastav (1985) Modern Text Book of Botany Vol. I Algae, Fungi,
1. Bacteria Viruses and Lichen, Universal Publication, Agra.
2. Biswas, S. B. and Amita Biswas (1986 Ed.) An Introduction to Viruses, Vikas Publishing House (P) Ltd. New Delhi.
3. Vashista, B.R. (2010) S. A Text Book of Algae S. Chand and Company (P.) Ltd New Delhi.
4. Vashista, B.R. (2010) S. A Text Book of Fungi S. Chand and Company (P.) Ltd New Delhi.
5. Sarabhai, B. P. & Arora C.K. (1995). A Text Book of Algae Anmol Publication, New Delhi.
6. Salle, A.J. (1974) Fundamental Principles of Bacteriology (TMH Ed.) New Delhi.
7. Gangulee, H.C. and Kar, A.K. (1998) College Botany Vol. II New Central Book Agency, Kolkota.
8. Pandey B. P. (2014) College Botany Volume 1S. Chand publications, New Delhi.
9. Pandey, S. N. and Trivedi (1997) A Text Book of Botany Vol. I Vikas Publishing House, New Delhi.
10. Sharma, P D. (1998) A Text Book of Fungi Rastogi Publication, Meerut.
11. Sharma, P D. (2009) A Text Book of Algae Tata McGraw Hill Publication, New Delhi

## Course Code: BO-112

### Course Title: Morphology of Angiosperms

<b>Course Code: BO-112</b>	<b>Course Category: Core Course (DSC)</b>
<b>Course Title: Electrostatics and Electricity</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To inculcate the students with angiosperm plant body.</li><li>2. To study the vegetative characteristics of the angiospermic plants.</li><li>3. To study the reproductive characteristics of the angiospermic plants.</li><li>4. To study plant parts, their modifications and functions.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Students will able to understand ground plan of angiospermic plant.</li><li>2. Students will aware about vegetative and reproductive characteristics of angiospermic plant.</li><li>3. Students will able to understand the modifications and functions of plant parts.</li></ol>	

### Course Content:

#### Unit 1: Introduction:

(10 L, 50 M)

- 1.1 Definition, scope and importance of Morphology
- 1.2 Study of Root and Stem: Definition, General characters and functions of root.
- 1.3 Types of root: Tap and Adventitious
- 1.4 Modifications of root:
  - a) Food storage: Fusiform, Conical, Napiform, Tuberosusroot.
  - b) Support: Stiltroots, Climbingroots.
  - c) Breathing: Pneumatophores.
  - d) Specialfunctions: Epiphyticroots, Suckingroots.
- 2.5 Definition, General characters and functions of stem
- 2.6 Types of Stem: Strongand Weak
- 2.7 Modifications of stem:
  - a) Underground: Rhizome and Stem tuber

- b) Sub-aerial: Runner and Stolon
- c) Aerial: Phylloclade and Cladode

## **Unit 2: Study of Leaf and Inflorescence**

**(09 L, 50 M)**

- 2.1 Definition, Parts of typical leaf and functions
- 2.2 Types of Leaf a) Simple b) Compound and its subtypes.
- 2.3 Phyllotaxy: Alternate, Opposite (Decussate and Superposed) and Whorled.
- 2.4 Venation: types of venations (Reticulate and Parallel)
- 2.5 Modifications of leaf: leaf spines, leaf tendrils and Pitcher.
- 2.6 Definition and parts of Inflorescence
- 2.7 Types of Inflorescence
  - a) Racemose: Raceme, Spike, Spikelet, Catkin, Spadix, Corymb, Umbel, Capitata and Head or Capitulum
  - b) Cymose: Solitary, Uniparous, Biparous and Multiparous cyme  
Specialtype: Cyathium, Verticillaster and Hypanthodium

## **Unit 3: Study of Flower:**

**(07 L, 50 M)**

- 3.1 Definition, Parts of typical flower
- 3.2 Types of flower: Hypogynous, Epigynous and Perigynous
- 3.3 Symmetry of flower : Actinomorphic and Zygomorphic
- 3.4 **Calyx**: Types of Calyx- Deciduous calyx and Persistent calyx
- 3.5 **Corolla**:
  - a) Forms of polypetalous corolla: Cruciform, Caryophyllaceous, Rosaceous and Papilionaceous
  - b) Forms of gamopetalous corolla: Campanulate, Infundibuliform, Tubular, Rotate, Hypocrateriform, Ligulate, Bilabiate and Personate
- 3.6 Perianth: Polyphyllous and Gamophyllous
- 3.7 Aestivation: Types of Aestivation.
- 3.8 **Androecium**:
  - a) Attachment of anther to filament: Basifixed, Dorsifixed and Versatile
  - b) Cohesion and Adhesion of stamens.
- 3.9 **Gynoecium**:
  - a) Apocarpous, Syncarpous, Monocarpellary, Bicarpellary and Polycarpellary
  - b) Placentation: Types of Placentation.

## **Unit 4: Study of Fruits:**

**(04 L, 50 M)**

- 4.1 Definition, Parts of typical fruit
- 4.2 Types of fruits:
  - A) Simple fruits:
    - i) Dry fruits:
      - a) Dehiscent: Legume

- b) Schizocarpic: Lomentum
- c) Indehiscent: Caryopsis
- ii) Fleshyfruits: Drupe
- B) Aggregate fruits: Etaerio of berries
- C) Compositefruits: Syconus.

### Reference Books:

1. Gangulee H.C. Das K.S. ,Dutta C .(2014)College Botany Volume I, New Central Book Agency (P) Ltd. .Kolkata.
2. Dutta A.C.(2013) Botany for Degree Students, Sixth edition, Oxford University Press, New Delhi.
3. Sachdeva S.K.(1990)Angiosperms–Morphology, Anatomy, Taxonomy, Evolution, Kalyani Publication, Ludhiana.
4. Pandey S.N. Mishra S.P. (2009) Taxonomyof Angiosperms, Ane Books Pvt .Ltd .,New Delhi.
5. Singh M.P., Sharma A.K. (2002)Text book of .Botany, Anmol Publication,Pvt.Ltd.,NewDelhi.
6. Sundararajan S.(2003) Practical Manual of Plant Morphology, AnmolPublication, Pvt .Ltd., New Delhi
7. BendreA.KumarA.(1999)ATextbookofPracticalBotanyII,RastogiPublicatio n,Meerut

## Course Code: BO-113

### Course Title: Practical based on BO 111 and BO 112

<b>Course Code: BO-113</b>	<b>Course Category: Core Course (DSC)</b>
<b>Course Title: Practical based on BO 111 and BO112</b>	<b>Type: Practical</b>
<b>Total Contact Hours: 60 (4/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To study the diversity among microbes.</li><li>2. To study systematic, morphology and structure of Bacteria, Viruses, Algae and Fungi.</li><li>3. To study the life cycle pattern of Bacteria, Viruses, Algae and Fungi.</li><li>4. To study the useful and harmful activities of Bacteria, Viruses, Algae and Fungi.</li><li>5. To inculcate the students with angiosperm plant body.</li><li>6. To study the vegetative characteristics of the angiospermic plants.</li><li>7. To study the reproductive characteristics of the angiospermic plants.</li><li>8. To study plant parts, their modifications and functions.</li></ol>	
<b>Course Outcomes:</b> <p>After the completion of the course the students will be able to:</p> <ol style="list-style-type: none"><li>1. Develop understanding about the classification and diversity of different microbes including viruses, Algae, Fungi &amp; Lichens &amp; their economic importance.</li><li>2. Learn host -pathogen relationship and disease management. • Gain Knowledge about uses of microbes in various fields.</li><li>3. Understand the structure and reproduction of certain selected bacteria algae, fungi and lichens</li><li>4. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes.</li></ol>	

### List of Experiment: B0111

**Practical 1:** Study of Equipment, Chemicals and Stains used in Botany laboratory:

A. Equipment: Dissecting microscope, Compound Microscope

B. Chemicals:

i) **Preservatives:** FAA

ii) **Stains:** Safranin, Light green, Fast green, Cotton blue, Crystal violet

iii) **Mounting media;** Glycerine, Lactophenol

**Practical 2: A.** Study of viruses and bacteria using electron photomicrographs (Bacteriophage, Cocci, Bacillus, Spirillum Bacteria).

**B. Technique of Gram staining of bacteria.**

**Practical 3 and 4:** Study of Plant diseases w.r.t. causal organism, symptoms and control measures of the following:

**A. Virus.**

- i. Yellow vein mosaic disease of Lady's finger
- ii. Bunchy top of Banana

**B. Bacteria**

- i. Citrus canker
- ii. Black arm of cotton

**C. Fungi**

- i. Green mould of citrus fruits/ Sigatoka of banana (Any one)
- ii. White rust disease /Tikka disease on groundnut (Any one)



**Practical 5:** Study of lichens and Mycorrhiza

- A. Study of growth forms of lichens (Crustose, Foliose and Fruticose) specimens / P.S./ Photographs
- B. Study of Mycorrhiza: (Ectomycorrhiza and Endomycorrhiza) by Photographs

**Practical 6:** Study of systematic position, vegetative and reproductive structures of *Nostoc*

- i. Vegetative structure -Filament and cell
- ii. Reproductive structure (P.S.)

**Practical 7:** Study of systematic position, vegetative and reproductive structures of *Aspergillus*

- i. Structure of thallus: mycelium,
- ii. Reproductive structures asexual (Conidiophore and Conidia)

**Submission:** Excursion tour report

**Note:** Duly certified journal is compulsory at the time of practical examination.

**List of Experiment: BO-112**

**Practical 8:** Study of morphology of root and modifications as per theory.

**Practical-9:** Study of morphology of stem and modifications as per theory.

**Practical 10:** Study of leaf morphology (as per theory):

- a) Parts of leaf
- b) Types of leaf
- c) Types of phyllotaxy

**Practical -11:** Study of venation, its types and modifications of leaf as per theory

**Practical-12:** Study of inflorescence and its types as per theory.

**Practical -13:** Study of accessory whorls of flower:

- a) Calyx–types of calyx as per theory
- b) Corolla –types of corolla as per theory
- c) aestivation and its types.

**Practical--14:** Study of essential whorls of flower:

- a) Androecium – Cohesion and Adhesion
- b) Gynoecium– types of placentation.

**Practical-15:** Study of fruits and its types as per theory.

**Submission:** Excursion tour report

**Note:** Duly certified journal is compulsory at the time of practical examination.

**Course Code: BO-114**

**Course Title: Biofertilizers**

<b>Course Code: BO-114</b>	<b>Course Category: Minor Course (MIN)</b>
<b>Course Title: Biofertilizers</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To understand the diversity and utilization of microbes as a biofertilizers</li><li>2. To demonstrate the low-cost production of biofertilizers.</li><li>3. To aware the students about the benefits and significant role of biofertilizers, to protect the agricultural environment.</li><li>4. To learn the applications of biofertilizers.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Able to distinguish types of biofertilizers and the methods of application.</li><li>2. Acquire skill of isolation and maintenance of biofertilizers</li><li>3. Able to understand the importance of biofertilizers in relation to environment</li><li>4. Able to understand formulation and large-scale industrial production of biofertilizers.</li></ol>	

### **Course Content:**

**Unit 1: (06 L, 50 M)**

- 1.1 Introduction, scope and importance of biofertilizers
- 1.2 Manures and biofertilizers: Types of fertilizers, manures, manure composition, manure for crop productivity.
- 1.3 Difference between Chemical fertilizers and biofertilizers.
- 1.4 General accounts on the microbes used as a biofertilizers

**Unit 2: (06 L, 50 M)**

- 2.1 *Azospirillum*: isolation and mass multiplication, carrier-based inoculant, applications

2.2 *Azotobacter*: Classification, characteristics, crop response, to *Azotobacter* inoculum, maintenance, mass multiplication

2.3 *Rhizobium*: isolation and mass multiplication, applications.

**Unit 3:** (06 L, 50 M)

3.1 Types of Algal Biofertilizers: BGA-Cyanobacteria, *Azolla*, isolation and mass multiplication of cyanobacteria and *Azolla*.

3.2 Applications of algal Biofertilizers

3.3 Biological Nitrogen Fixation.

**Unit 4:** (12 L, 50 M)

4.1 Mycorrhizal Association, types of mycorrhizal association, occurrence and distribution, growth and yield.

4.2 Colonization of VAM (Vesicular Arbuscular Mycorrhiza)

4.3 Application of mycorrhiza in agriculture

4.4 Green manuring and organic fertilizers

4.5 Recycling of biodegradable agricultural and industrial waste

4.6 Bio compost making methods: Farm Yard, Green leaf Compost.

#### **Reference Books:**

1. Aneja, K. R. 1993 Experiments in Microbiology, Plant Pathology and Tissue Culture Wishwa Prakashan New Delhi.
2. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology Woodhead Publisher, India, New Delhi
3. Dubey R.C. 2005. A Text book of Biotechnology. S.Chand & Co. New Delhi.
4. John Jothi Prakash E. 2004. Outlines of Plant Biotechnology. Emkay Publication. New Delhi
5. Kumaresan, V. (2005). Biotechnology. New, Delhi, Delhi: Saras Publication
6. Sathe T.V. 2004. Vermiculture and Organic Farming. Daya Publishers. New Delhi.
7. Subha Rao, N.S. (2000). Soil Microbiology. New Delhi, Delhi: Oxford & IBH Publishers.
8. Vayas S.C, Vayas S. and Modi H.A. 1998. Bio-fertilizers and organic Farming Akta, Prakashan.

**Course Code: BO-115**

**Course Title: Practical based on BO 114**

<b>Course Code: BO-115</b>	<b>Course Category: Minor Course (MIN)</b>
<b>Course Title: Practical based on BO 114</b>	<b>Type: Practical</b>
<b>Total Contact Hours: 60 (4/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> 1. To understand the diversity and utilization of microbes as a biofertilizers 2. To demonstrate the low-cost production of biofertilizers. 3. To aware the students about the benefits and significant role of biofertilizers, to protect the agricultural environment. 4. To learn the applications of biofertilizers.	
<b>Course Outcomes:</b> 1. Understand the role of different physiological and metabolic processes of plants. 2. Practical knowledge of the different statistics tools and techniques. 3. Develop conceptual skill about identifying microbes, pathogens, biofertilizers etc. 4. Gain knowledge about developing commercial enterprise of microbial products. 5. Understand methods of isolation and purification of microbial cultures	

**List of Experiment:**

Practical-1 Introduction to microscope and equipment's

Practical-2 Methods of sterilization

Practical-3 & 4 Study of microbes used as biofertilizers (Bacteria, Algae and Fungi) with the help of material/slide/photographs

Practical-5 & 6 Nutritional media and their preparation

Bacterial- YEMA (Yeast Extract Mannitol Agar), Algal- Chu's medium

Fungal- PDA (Potato Dextrose Agar)

Practical-7 Methods of isolation and purification of microbial cultures

Practical- 8 & 9 Isolation of *Rhizobium* from leguminous root nodule

Practical-10 & 11 Isolation of *Azotobactor* from soil

Practical- 12 Isolation of BGA from Paddy fields

Practical- 13 Isolation of *Anabaena* from Azolla leaf.

Practical- 14 Mass cultivation of BGA

Practical- 15 Isolation of mycorrhiza (VAM) from soil

**Course Code: BO-116**

**Course Title: Plant Nursery Management**

<b>Course Code: BO-116</b>	<b>Course Category: Open Elective Course (OE) (To be chosen compulsorily from faculty other than that of the Major)</b>
<b>Course Title: Plant Nursery Management</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To provide knowledge about basic concepts and principles of nursery techniques.</li><li>2. To impart basic and technical knowledge on nursery management for strengthening of horticulture sector.</li><li>3. To study the disease and pest controlling nursery with practical experience.</li><li>4. To help students to study marketing and management relating to nursery.</li><li>5. To help students to manage nurseries and propagate healthy plants on a commercial scale.</li><li>6. To improve knowledge of green house, Polyhouse, Vertical farming and hydroponics.</li><li>7. To impart entrepreneurship skill in nursery management among the students</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Understand the importance of a plant nursery and basic infrastructure to establish it.</li><li>2. Explain the basic material, tools and techniques required for nursery.</li><li>3. Demonstrate expertise related to various practices in a nursery.</li><li>4. Comprehensive knowledge and skills to get an employment or to become an entrepreneur in Plant nursery sector.</li><li>5. To Know Green house and Polyhouse technology.</li><li>6. To know vertical farming, Hydroponic technique.</li></ol>	

## Course Content:

### Unit 1: Plant nursery

(04 L, 50 M)

- 1.1 Introduction, definition and importance.
- 1.2 Types of nurseries:
  - a) Temporary: Features, Advantages and disadvantages.
  - b) Permanent: i) Features, Advantages and disadvantages.  
ii) Ornamental, Vegetable, Fruit plant, Forest plant, Open field and High-tech nurseries.
- 1.3 Selection of place, lay out and components of a good nursery.
- 1.4 Important role of nursery in horticulture development.

### Unit 2: Nursery: Basic requirement and setup.

(10 L, 50 M)

- 2.1 Nursery beds – types and precautions to be taken during preparation.
- 2.2 Growing media, nursery tools and implements, and containers in brief.
- 2.3 Soil and seed treatments, sowing of seeds and planting material used for nursery.
- 2.4 Plant propagation Technique:
  - a) Sexual propagation: Advantages and dis-advantages
  - b) Asexual propagation: Advantages and dis-advantages.
    - Cutting: Root, Stem and leaf cutting
    - Layering: Simple and Air layering (Gootee)
    - Budding: T- and Patch budding
    - Grafting: Whip and tongue grafting.
- 2.5 Green house and Polyhouse: Types and importance

### Unit 3: Nursery: Management practices

(10 L, 50 M)

- 3.1 Potting and repotting, application of manures and fertilizers.
- 3.2 Plant bio-regulators and growth retardants, Water quality and management.
- 3.3 Common diseases, pests, care and management of nursery plants.
- 3.4 Seasonal activities and routine operations in a nursery.
- 3.5 Common possible errors in nursery activity.
- 3.6 Bureau of Indian Standards (BIS-2008) related to nursery.
- 3.7 Economics of nursery development, pricing and record maintenance.
- 3.8 Packing, transport, Branding and marketing of nursery plants.
- 3.9 Entrepreneurship development through nursery.

### Unit 4: Vertical farming and Hydroponics.

(06 L, 50 M)

- 4.1 Vertical Farming: Introduction, scope and importance.
- 4.2 Plants suitable for vertical farming.

- 4.3 Advantages of vertical farming.
- 4.4 Hydroponics: Introduction, scope and importance.
- 4.5 Basic concepts and designs, Importance of light, temperature and humidity.  
Nutrient film technique (NFT)
- 4.6 Advantages and Plants suitable for hydroponics.

### **Reference Books:**

1. Bose, T.K. Sanyal, Dand Sandhu, M.L. (1998) Propagation of Horticultural crops. Naya Prakash Publishers, Kolkatta.
2. K.K. Nanda and V.K. Kochhar (1985). Vegetative propagation of plants. Kalyani Publisher-NewDelhi-Ludhiana.
3. Kunte, Y.N., Kawthalkar, M.P.and Yawalkar, K.S. (2005). Principles of Horticulture and Fruit Growing. Agri-Horticultural Publishing House, Nagpur.
4. Rahudkar W.B., Bhujbal B.G.,Madhuri Sonawane, Hemraj Rajput ,(2010), CMOU, Text book Publication No. AGR 227Horticulture Nursery Management.
5. Randhawa G.S., A. Mukhopadhyay (2001). Floriculture in India. Book published by Allied Publishers Limited, New Delhi
6. Ratha Krishnan, P. Kalia Rajwant K. Tewari, J.C., Roy M.M., (2014).Plant Nursery Management: Principles and Practices, Central Arid Zone Research Institute (I.C.A.R.)Jodhpur
7. Sharma, R. Rand Srivastav M (2004):Plant propagation and nursery management (First Edition) International Book Distributing Co.
8. Sharma, R.R.(2002). Propagation of Horticultural Crops(Principles and practices).
9. Sharma,R.R. andKrishna, H.(2013). A text book of plant propagation and nursery management. Intl Book Distributing Co., Lucknow.
10. Andy Jacobson: Hydroponic Gardening Guide to Grow Fruit, Vegetables and Herbs at Home
11. Keith Roberto: How to Hydroponics 4<sup>th</sup> Edition.
12. Dr J. Benton Jones: Hydroponics: A Practical Guide for the soilless Grower (2<sup>nd</sup> Edition).
13. John Mason: Commercial Hydroponics.



**Course Code: BO-117**

**Course Title: Herbal Techniques**

<b>Course Code: BO-117</b>	<b>Course Category: Skill Enhancement Course</b>
<b>Course Title: Herbal Techniques</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>

**Course Objectives:**

1. Health and Wellness: The primary objective of herbal techniques is often to promote health and well-being.
2. Traditional Knowledge Preservation: Many herbal techniques are rooted in traditional knowledge and practices passed down through generations.
3. Complementary Medicine: Herbal techniques can complement conventional medical treatments. The objective here is to integrate herbal remedies into mainstream healthcare to enhance treatment outcomes and reduce side effects.
4. Research and Development: Advancing scientific understanding of herbal medicine is another key objective. This involves conducting research on the efficacy and safety of herbal remedies, as well as developing new herbal products and formulations.

**Course Outcomes:**

1. Students will acquire a comprehensive understanding of various medicinal plants, including their botanical identification, habitat, traditional uses, and active constituents.
2. Students will be able to develop the ability to prepare herbal remedies through techniques such as decoction, infusion, tincture making, salve preparation, and herbal formulation.
3. Encouragement to students for holistic approach to health by emphasizing the interconnectedness of physical, mental, and emotional well-being in herbal practices.
4. Students will understand the safety aspects of herbal medicine, including potential interactions with medications and contraindications for specific populations (e.g., pregnant women, children).
5. Herbal Formulation and Dosage: Learn how to formulate herbal remedies for specific health conditions and determine appropriate dosages based on individual needs.

## Course Content:

### Unit1: Introduction to Herbal Techniques

(08 L, 00 M)

#### 1.1 Introduction to Herbal Techniques

Introduction, History, Scope,

Classification of crude drugs Taxonomical, Morphological, Chemical, Therapeutical, Geographical and Alphabetical.

#### 1.2 Indian systems of medicine:

- a) Ayurveda   b) Unani   c) Homeopathic   d) Siddha
- e) Yoga        f) Naturopathy

#### 1.3 Botanical source, classification, macroscopic characters, Parts used, properties and medicinal uses of common house hold plants:

- i) Kalmegh, *Andrographispaniculata*
- ii) Haldi, *Curcuma domestica*
- iii) Murud sheng, *Helecterisisora*
- iv) Tulsi, *Ocimum sanctum*
- v) Senna, *Cassia angustifolia*

### Unit 2: Herbal formulations and analytical testing:

(08 L, 50 M)

- a) A Comparative study of herbal and modern dosage forms.
- b) Classification, general consideration, Different steps of herbal Formulation:
  - i) Grinding   ii) Extraction   iii) Filtration   iv) Concentration.
- c) Different dosage forms:
  - i) Infusion   ii) Decoctions   iii) Tincture
- c) Testing of herbal drugs, Screening tests for Alkaloids, Flavonoids, Steroids, Terpenoids.

### Unit3: Characteristics of herbal plants and Principles of Herbal drugs.

(07 L, 50 M)

A] biological and chemical characteristics of some important drug containing plants:- 1) Clove 2) Black Pepper 3) Coriander 4) Eucalyptus

B] Principles involved in the preparation and standardization of following formulations :- Aristas, Asava, Gutica, Taila, Churna, , Bhasma.

### Unit 4: Morphology, Distribution, Botanical characterization of drug constituent, chemical test and uses of following drugs:- (07 L, 50 M)

- a) Root drug: i) Shatawari, Aswagandha,
- b) Stem/ Bark drug: i) Neem.Cinnamone.

- c) Leaf drug: i) Adulsa, Korpad.
- d) Fruit drugs: i) Hirda, Behada, Amla.

**Reference Books:**

1. Gokhale S.B. (1979) Text book of Pharmacognosy, Jay Publishing house Jalgaon
2. Kalianna Girija (1993) All about herbal remedies, Vikas publishing house New Delhi.
3. Kaushik Purshottam and Dhiman A.K. (2000) Medicinal Plants and herbal drugs of India Bishen Singh and Mahendra pal Singh Dehradun India
4. Pharmacognosy by Kokate, Purohit, Gokhale.
5. Atul Roy 2012 Oxford Book 10 Company, Jaipur.
6. K.R.Khandelwal "Practical Handbook"
7. Rangari "Pharmacognosy and phytochemistry"
8. Gokhali "Cultivation and Collection."
9. Pharmacognosy part I by Rumi M.Shah & Rupesh T. Nayak.
10. H.K.Bakur 2012 Herbal that heal Orient Paperbacks Delhi.
11. A Hand book of Medicinal Plants. A complete source book by Prajapati, Purohit, Sharma, Kumar. Agrobias India.
12. Beauty through Herbs Dr.Urjita Jain. Institute of herbal science Andhari Mumbai.
13. Drugs from Plant, Prof P.C.Trivadi, Aavishker Publisher, Jaipur.
14. Practical Pharmacognosy, Dr K.K.Khandewal, Nirali Prakashan.
15. Pharmacognosy, C.K.Kokate, A.P.Purohit, S.B. Gokhale, Nirali Prakashan.

**Course Code: BO-121**

**Course Title: Diversity of Higher Cryptogames**

<b>Course Code: BO-121</b>	<b>Course Category: Core Course (DSC)</b>
<b>Course Title: Diversity of Higher Cryptogames</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To study salient features of higher Cryptogams.</li><li>2. To know the morphology and systematic of higher cryptogams.</li><li>3. To study the life cycles of selected genera.</li><li>4. To study economic importance of higher cryptogams.</li><li>5. To make the students aware about conservation and sustainable use of plants.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Student will be able to understand the basic knowledge of the subject.</li><li>2. To understand the basic structure and study the comparative characteristic of Bryophytes and Pteridophytes.</li><li>3. To understand the structural similarities and differences among both the groups.</li><li>4. Student will be able to aware developmental stages of life cycle of higher cryptogrammic plants. To facilitate students for taking up and shaping asuccessful career in botany.</li></ol>	

## **Course Content:**

### **Unit 1: Introduction:**

**(04 L, 50 M)**

1.1 : Introduction, definition and Diversity of higher cryptogams.

1.2 : **Bryophytes:** Introduction, definition, and general characteristics of Bryophytes.

1.3 : Habit and Habitat.

1.4 : Classification of Bryophytes according to G. M. Smith (1955) up to classes

with reasons, giving at least two examples from each class.

1.5 : Economic importance of Bryophytes.

## **Unit 2: Study of life cycles of Bryophytes**

**(09 L, 50 M)**

### **2.1 Study of Life cycle of *Riccia*:**

2.1.1 : Systematic position with reasons.

2.1.2 : Habit and habitat.

2.1.3 : External and internal structure of gametophytes

2.1.4 : Vegetative reproduction.

2.1.5 : Sexual reproduction (Development of sex organs not expected)

2.1.6 : Fertilization.

2.1.7 : Structure of mature sporophyte.

2.1.8 : Structure and germination of spores.

2.1.9 : Alternation of generation.

### **2.2 Study of lifecycle of *Funaria*:**

2.2.1. Systematic position with reasons.

2.2.2 : Habit and habitat.

2.2.3 : External and internal structure of gametophyte.

2.2.4 : Vegetative reproduction.

2.2.5 : Sexual reproduction (Development of sex organs not expected)

2.2.6 : Fertilization.

2.2.7 : Structure of mature sporophyte.

2.2.8 : Alternation of generation.

## **Unit 3: Pteridophytes:**

**(04 L, 50 M)**

3.1: Introduction, definition and general characteristics of Pteridophytes.

3.2: Habit and Habitat.

3.3: Classification of Pteridophytes according to G. M. Smith (1955) up to classes with reasons, giving at least two examples from each class.

3.4: Economic importance of Pteridophytes.

## **Unit 4: Study of life cycles of Pteridophytes**

**(13 L, 50 M)**

### **4.1. Study of life cycles of *Adiantum*:**

4.1.1 : Systematic position with reasons.

4.1.2 : Habit and habitat.

4.1.3: External and internal structure of sporophyte.  
4.1.4: Asexual reproduction: position and structure of sorus.  
4.1.5:

Structure of sporangium.

4.1.6 : Structure and germination of spores.  
4.1.7 : Structure of mature gametophyte.  
4.1.8 : Position and structure of sex organs.

(Development of sex organs not expected).

4.1.9 : Fertilization.

4.1.10 : Alternation of generation.

#### **4.2. Study of life cycle of *Selaginella*:**

4.2.1 : Systematic position with reasons.

4.2.2 : Habit and habitat.

4.2.3 : External and internal structure of sporophyte.

4.2.4 : Asexual reproduction: position and structure of strobilus.

4.2.5 : Sporangia (Megaspore and microspore).

4.2.6 : Structure and germination of spores.

4.2.7 : Structure of male and female gametophyte.

4.2.8 : Position and structure of sex organs.

(Development of sex organs not expected)

4.2.9 : Fertilization.

4.2.10 : Structure of mature embryo.

4.2.11 : Alternation of generations.

4.2.12 : Heterospory and its significance.

#### **Reference Books:**

1. Gangulee, H.C. and Kar, A.K.(2001).College Botany Vol.II. Books and Allied Press Ltd. Kolkata.
2. Pandey, S.N. and Trivedi, P.S.(1997). A Text Book of Botany Vol.II, Vikas Publishing House (P.) Ltd. New Delhi.
3. Parihar, N.S.(1977).Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
4. Parihar, N.S. (1984). An Introduction to Embryophyta Vol.I Bryophyta. Central Book Depot, Allahabad
5. Rashid, A.(1996).An Introduction to Bryophyta. Vikas Publishing House Ltd. New Delhi.
6. Rashid,A.(1996).An Introduction to Pteridophyta.Vikas Publishing House

7. Saxena,A.K.and Sarbhai,R.M. (1992).A Text Book of Botany Vol. II Embryophyta. Ratan Prakashan Mandir, Agra.
8. Smith, G.M.(1995).Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes).  
McGraw-Hill Book Company, New York and London.
9. Sporne,K.R.(1995).The Morphology of Pteridophyta. The Hutchinson University Library, London,U.K.
10. Vashistha, B.R. (1997).Botany For Degree Students Bryophyta. S. Chand and company (P.)Ltd.New Delhi.
11. Vashistha,P.C. (1984).Pteridophytes. S.Chand and company (P.)Ltd.New Delhi

**Course Code: BO-122**

**Course Title: Plant Anatomy**

<b>Course Code: BO-122</b>	<b>Course Category: Major Specific (DSC)</b>
<b>Course Title: Plant Anatomy</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To know scope and importance of plant anatomy.</li><li>2. To study various tissue systems with their functions.</li><li>3. To know internal structure of dicot and monocot plants. Including the functions of different layers.</li><li>4. To study normal secondary growth in plants and their causes.</li><li>5. To study functions and structure of protective tissue system.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Students will know scope and importance of plant anatomy</li><li>2. Students will have knowledge of various tissue systems with their functions.</li><li>3. Students will have knowledge of internal structure of dicot and monocot plants along with difference.</li><li>4. Students will know the process and causes of normal secondary growth in plants.</li><li>5. They will know functions and structure of protective tissue system</li></ol>	

### **Course Content:**

#### **Unit 1: Introduction**

**(9 L, 00 M)**

1.1 Introduction, Definition and History of Plant anatomy

1.2. Scope of plant anatomy in Systematics, Forensics and Pharmacognosy.

1.3 Plant Tissues: Definition and Classification of tissues- Meristematic tissues, Permanent tissues and Secretory tissues

1.4 Meristematic tissue



- i. Characteristics of Meristematic tissues,
- ii. Types / Classification of Meristematic tissues
  - a) based on origin. b) based on position.

#### 1.5- Permanent tissues- i. Characteristics of Permanent tissues

##### ii. Types of Permanent tissues

(A) Simple tissues B) Complex tissues.

A. Simple tissues: i. Definition ii. Types of simple tissues:

a) Parenchyma: i. Characteristics ii. types (Aerenchyma, Chlorenchyma)

iii. Functions.

b) Collenchyma: i. Characteristics ii. Types (Angular, Lacunar and Lamellar)

iii. Functions.

c) Sclerenchyma: i. Characteristics ii. Types (Fibres and Sclereids)

iii. Functions iii. Differences between the parenchyma, Collenchyma and Sclerenchyma

(B) Complex tissues: i. Definition

ii. Types of Complex tissues Xylem i. Components / Elements of xylem

ii. Characteristics iii. Functions of xylem

(b) Phloem i. Components / elements of phloem.

ii. Characteristics iii. Functions of phloem.

#### 1.6 -Types of Vascular bundles –Conjoint- collateral open and closed, Bicollateral V.B., Concentric bundles, Radial V.B .

#### 1.7-Secretory tissues: (i) Characteristics

(ii) Functions of secretory tissues .

(iii) Types- a. Digestive glands b. Nectarie c. Hydathodes

d. Resin ducts e. Laticiferous ducts

## **Unit 2: Protective Tissue System**

**(07 L, 50 M)**

2.1-Epidermal Tissue System: (i) Definition (ii)Function

2.2- Types of Epidermal Appendages with structure and characteristics

i) Unicellular, Multicellular (Uniseriate and Multiseriate) Trichomes

ii) Glandular, Non-glandular Trichomes

iii) Stellate, Dendroid Trichomes and Peltate scales

2.3 – Stomata (i) Structure (ii) Functions

(iii)Types : Ranunculaceous (Anomocytic), Cruciferous (Anisocytic).

Rubiaceous (Paracytic) Caryophyllaceous (Diacytic) Graminaceous

## **Unit 3: Internal Structure of Dicotyledonous (Sunflower) and Monocotyledonous (Maize) Root, Stem and Leaf**

**(07 L, 50 M)**

3.1 Primary structure of monocot (Maize) root

3.2 Primary structure of dicot. (Sunflower) root

3.3 Differences between monocot and dicot root

3.4 Primary structure of monocot (Maize) stem

3.5 Primary structure of dicot(Sunflower) stem

3.6 Differences between monocot and dicot stem

3.7 Primary structure of monocot (Maize) Leaf

3.8 Primary structure of dicot (Sunflower) Leaf

3.9 Differences between monocot and dicot leaf

## **Unit 4: Normal secondary growth in dicot stem**

**(07 L, 50 M)**

4.1 Definition and Significance of secondary growth.

4.2 Steller secondary growth:

a) Cambium types: Inter fascicular cambium , Intrafascicular cambium, cork cambium, vascular cambium.

b) Formation of cambium ring

c) Formation of secondary tissues: Xylem (Wood), Phloem and Medullary rays.

d) Formation of annual rings, Heart wood and Sap wood

4.3 Extra-Steller secondary growth:

- a) Activity of of cork cambium,(phellogen), phellem or cork,phellocoderm and periderm
- b) Formation of lenticels.

### **Reference Books:**

- 1) Carlquist, S. (1961) Comparative Plant anatomy. Hold, Rinehart and Winson, New York, USA.
- 2) Chandurkar, P.J, (1971) Plant Anatomy (3rd Ed.), Oxford and IBH Publishing Co. New Delhi and Bombay, India.
- 3) Choyal Rajaram (2012) Plant Anatomy and Physiology, Sonali Publications, New Delhi, India. .
- 4) Cutter, E. G. (1971) Plant Anatomy: Experimentand Interpretation Part-II, Organ. Edward Arnold, London, UK.
- 5) Das Susheela, M. (2017) A Text Book of Plant Anatomy. Dominant Publishers and Distributers Pvt. Ltd., New Delhi, India.
- 6) Eames, A.J. and L.H. Mc Daniels (1947) An Introduction to Plant Anatomy, (2nd Ed.).McGraw Hill Co. New York, USA.
- 7) Esau, K. (1977) Anatomy of Seed Plants (2nd Ed.).John Wiley, New York, USA.
- 8) Fahn, A. (1982) Plant Anatomy (3rd Ed.) Pergman Press, Oxford andNew York. USA.
- 9) Grewal, R.C. (2011) Plant Anatomy. Campus Books International, New Delhi, India.
- 10) Mauseth, J.D. (1988) Plant Anatomy. The Benjamin/Cummings Publisher, USA.
- 11) Menan , A.B. (2008) Introduction to Plant Anatomy. Rajat Publications, New Delhi, India.
- 12) Pandey, B.P. (1954) Plant Anatomy.S. Chand and Co. (P.) Ltd. New Delhi, India.
- 13) Pandey, S.N. and A. Chadha (2006) Plant Anatomy and Embryology. Vikas Publishing House Pvt., Ltd., New Delhi, India.
- 14) Sharda, Tarun P. (2012) An Introduction to Plant Anatomy. Alfa Publications, New Delhi, India.
- 15) Sharma Rajani (2009) An Introduction to Plant Anatomy. Campus Books

International, New Delhi, India.

- 16) Singh Sanjay Kumar ((2005) Text Book of Plant Anatomy. Campus Books International, New Delhi, India.
- 17) Singh, S. K., and Seema Srivastava (2011) Anatomy of Angiosperm. Campus Books International, New Delhi, India.
- 18) Singh, V., P.C. Pande and D.K. Jain (1998) Anatomy of Seed Plants. Rastogi Publications, Meerut, India.
- 19) Singh, V., P. C. Pande and D.K. Jain (2013) A Text Book of Botany Angiosperm. Rastogi Publications, Meerut, India.
- 20) Tandan Neeraj (2014) An Introduction to Plant Anatomy. Anmol Publications, Pvt., Ltd., New Delhi, India.
- 21) Tayal, M.S. (1994) Plant Anatomy. Rastogi Publications, Meerut, India.
- 22) Vashista, P.C. (1986) Plant Anatomy. Pradeep Publications, Jalandhar, India.

## Course Code: BO-123

### Course Title: Practical based on BO 121 and BO 122

<b>Course Code: BO-123</b>	<b>Course Category: Core Course (DSC)</b>
<b>Course Title: Practical based on BO 121 and BO 122</b>	<b>Type: Practical</b>
<b>Total Contact Hours: 60 (4/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20 Marks</b>	<b>University Assessment (UA): 30 Marks</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To study salient features of higher Cryptogams.</li><li>2. To know the morphology and systematic of higher cryptogams.</li><li>3. To study the life cycles of selected genera.</li><li>4. To study economic importance of higher cryptogams.</li><li>5. To know scope and importance of plant anatomy.</li><li>6. To study various tissue systems with their functions.</li><li>7. To know internal structure of dicot and monocot plants. Including the functions of different layers.</li><li>8. To study normal secondary growth in plants and their causes.</li><li>9. To study functions and structure of protective tissue system.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Student will be able to understand the basic knowledge of the subject.</li><li>2. To understand the basic structure and study the comparative characteristic of Bryophytes and Pteridophytes.</li><li>3. To understand the structural similarities and differences among both the groups.</li><li>4. Student will be able to aware developmental stages of life cycle of higher cryptogramic plants.</li><li>5. To facilitate students for taking up and shaping a successful career in botany.</li><li>6. Students will know scope and importance of plant anatomy.</li><li>7. Students will have knowledge of various tissue systems with their functions.</li><li>8. Students will have knowledge of internal structure of dicot and monocot plants along with difference.</li><li>9. Students will know the process and causes of normal secondary growth in plants.</li></ol> They will know functions and structure of protective tissue syste	

### List of Experiment:

**Practical-1: Study of diversity of Bryophytes w.r.t systematic position and**

**morphology of:** *Marchantia* b) *Anthoceros* c) *Sphagnum*

**Practical-2: Study of *Riccia*:**

- 22.1 : Systematic Position with reasons
- 22.2 : External morphology
- 22.3 : Mounting of scales and rhizoids
- 22.4 : V. S. of Thallus
- 22.5 : V. S. of thallus showing antheridia [P. S.]
- 22.6 : V.S. of thallus showing archegonia [P.S.]
- 22.7 :V.S. of sporophyte [P.S.]

**Practical-3:Study of *Funaria*:**

- 3.1 : Systematic Position with reasons
- 3.2 : External morphology
- 3.3 : T. S. of axis
- 3.4 : V.S. of antheridial head [P.S.]
- 3.5 : V.S. of archegonial head P.S.]
- 3.6 : V.S. of Capsule[P.S.]
- 3.7 : Mounting of spores and peristomial teeth

**Practical-4: Study of diversity of Pteridophytes w.r.t systematic position and morphology of: *Psilotum* b) *Lycopodium* c) *Equisetum***

**Practical - 5: Study of *Selaginella*:**

- 5.1 :Systematic Position with reasons
- 5.2 : External morphology
- 5.3 : T. S. of Stem
- 5.4 : Mounting of micro and megaspores
- 5.5 : T. S. of Leaf [P.S.]
- 5.6 : V. S of Strobilus [P.S.]

**Practical - 6: Study of *Adiantum*:**

- 6.1 : Systematic Position with reasons
- 6.2 : External morphology
- 6.3 : T. S. of Rachis
- 6.4 : T. S. of Sorus [P. S.]
- 6.5 : Mounting of spores

**Practical - 7:** (a) Study of meristematic tissues with help of permanent slides/ photographs.

(b) Study of permanent tissues -simple tissues and complex tissues with help of permanent slides / photographs.

**Practical - 8:** Study of Trichomes with help of locally available materials.

**Practical - 9:** Study of Stomata types with help of locally available materials

**Practical -10:** Study of vascular bundles with help of locally available materials/permanent slides

**Practical -11:** Study of secretory tissues with help of permanent slides

**Practical -12:** Study of primary structure (Anatomy) of monocot (Maize) root and dicot. (Sunflower)root.

**Practical -13:** Study of primary structure (Anatomy) of monocot (Maize) stem and dicot. (*Tridax/ Sunflower*) stem

**Practical -14:** Study of normal secondary growth in Neem stem.

**Practical -15:** Study of Internal Structure (Anatomy) of monocot (Maize) leaf and dicot. (Sunflower) leaf with help of permanent slides .

- Submission:**
1. Any five photographs of higher cryptogamic plants
  2. Excursion tour report

**Note:** Short or long excursion tour and visit to any botanical garden are compulsory.

**Reference Books:**

**Course Code: BO-124**

**Course Title: Mushroom Technology**

<b>Course Code: Po-124</b>	<b>Course Category: Minor Course (MIN)</b>
<b>Course Title: Mushroom Technology</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To learn the history, scope and importance of mushroom technology.</li><li>2. To understand nutritional and medicinal values of edible mushrooms.</li><li>3. To know about the storage, marketing and various food preparations of mushrooms.</li><li>4. To understand the Diseases. Post harvesting techniques of Mushrooms.</li><li>5. To facilitate self-employment.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Understanding mushrooms, types (edible &amp; poisonous) and mushroom production.</li><li>2. Learning cultivation of different edible mushrooms.</li><li>3. Knowledge about climatic requirements of mushroom cultivation.</li><li>4. Knowing harvesting and post harvesting processes of mushroom.</li><li>5. Learning value added products preparation from mushroom.</li></ol>	

**Course Content:**

**Unit 1:** 1.1 Introduction and history of mushrooms, scope and importance of mushroom technology, cology and distribution of mushrooms. **(09 L, 50 M)**

1.2 Structure of mushrooms with special reference to Agaricus.

1.3 General account of mushrooms, Types of mushrooms.

i Edible mushrooms

ii Non-Edible/ Poisonous mushrooms.

1.4 Morphology and distinguishing characteristics of following mushrooms:

i. Button mushrooms (*Agaricus bisporus*)

ii. Oyster mushrooms(*Pleurotusostreatus*)



- iii. Paddy straw mushrooms(*Volvariellavolvacea*)
- 1.5 Medicinal value of edible mushrooms.
- 1.6 Research centers: National level and regional level.

**Unit 2: Mushroom Cultivation (12 L, 50 M)**

- 2.1 Mushroom cultivation requirements
- 2.2 Spore structure of mushroom.
- 2.3 Preparation of pure culture from spore.
- 2.4 Spawn preparation (mushroom seeds).
- 2.5 Spawn maintenance and storage.
- 2.6 Sterilization of substrates.
- 2.7 Compost preparation(wheat/paddy straw).
- 2.8 Mushroom bed preparation, pasteurization and spawning.
- 2.9 Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies.

**Unit 3: Nutraceutical value and Food preparation (04 L, 50 M)**

- 3.1 Composition and nutritional value: Proteins, amino acids, carbohydrates, fats, fiber contents, vitamins, mineral elements.
- 3.2 Types of foods prepared from mushroom: Soup, Cutlet, Omelette, Samosa, Pickles, Curry.

**Unit 4: : Storage, Packing and Marketing (02 L, 50 M)**

- 4.1 : Short-term storage (Refrigeration - upto 24 hours)
- 4.2 : Long term storage canning, Drying, storage in salt solutions.
- 4.3 Mushroom production and marketing in India.
- 4.4 Packing and transport of mushrooms.

**Reference Books:**

1. Mushroom Production and Processing Technology, Pathak Yadav Gour (2010). Published by Agrobios (India)
2. Pandey R.K, S. K Ghosh (1996). A Hand Book on Mushroom Cultivation. Emkey Publications.
3. Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.

4. V .N. Pathak, Nagendra Yadav and Maneesha Gaur(2000). Mushroom Production and Processing Technology/ Vedams Ebooks Pvt Ltd., New Delhi.
5. Shu Fing Chang, Philip G. Miles and Chang, S.T. 2004. Mushrooms Cultivation, nutritional value, medicinal effect and environmental impact. 2nd ed., CRC press.
6. Swarninathan, M. (1990). Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
7. S.C.Tewari. Pankaj Kapoor, (1988). Mushroom Cultivation, Mittal Publications. Delhi.
8. Nita Bahl (1984-1988). Hand book of Mushrooms, II Edition. Vol.I and Vol. II.
9. Vijaya Khader, (1993). Mushrooms for Livelihood. Kalyani Publishers. Pp170.
10. D. P. Tripathi, (2005). Mushroom cultivation. Oxford IBH Publishing Co. Pvt. Ltd.Pp354.
11. A hand book of edible mushroom, S.Kannaiyan& K.Ramasamy (1980). Today & Tomorrows printers & publishers, New Delhi.
12. P.K. Khanna and S. Kappor, (2007).Mannual of mushroom production. Dept. of Microbiology. College of Basic Sciences and Humanities, Punjab Agriculture University, Ludhiana. pp.86-90.
13. Paul Stamets, J.S. and Chilton, J.S. (2004). Mushroom cultivation A practical guide to growing mushrooms at home, Agarikon Press.
14. Marimuthu, T. Krishnamoorthi, A.S. Sivaprakasam, K. and Jayarajan. R (1991). Oyster Mushrooms. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.

## Course Code: BO-125

### Course Title: Practical based on BO 124

Course Code: <b>BO-125</b>	Course Category: <b>Minor Course (MIN)</b>
Course Title: <b>Practical based on BO 124</b>	Type: <b>Practical</b>
Total Contact Hours: <b>60 (4/week)</b>	Course Credits: <b>02</b>
College Assessment (CA) Marks: <b>20</b>	University Assessment (UA): <b>30</b>
<b>Course Objectives:</b> <ol style="list-style-type: none"><li>1. To learn practically scope and importance of mushroom technology.</li><li>2. To understand nutritional and medicinal values of edible mushrooms.</li><li>3. To know about the storage, marketing and various food preparations of mushrooms.</li><li>4. To understand the Diseases. Post harvesting techniques of Mushrooms.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. To Understanding mushrooms, types (edible &amp; poisonous) and mushroom production practically.</li><li>2. Learn cultivation of different edible mushrooms.</li><li>3. Knowledge about climatic requirements of mushroom cultivation.</li><li>4. Knowing harvesting and post harvesting processes of mushroom.</li><li>5. Learning value added products preparation from mushroom.</li></ol>	

### List of Experiment:

Practical No. 1 & 2 To study morphology of following Mushrooms.

- a. Button (*Agaricus bisporus*)
- b. Oyster (*Pleurotus ostreatus*)
- c. Paddy straw (*Volvariella volvacea*)

Practical No. 3 To study of Poisonous mushrooms

Practical No. 4 Study of Edible mushroom(Chart/Specimens)

Practical No. 5 & 6 Study of different types of compost required formushroom cultivation.

Practical No. 7 To study sterilization of glassware, equipment's, and culture media used in mushroom cultivation.

Practical No. 8 Demonstration of spawn preparation.

Practical No. 9, 10 & 11 Cultivation of *Agaricus bisporus* / *Pleurotus* / *Volvariella* *Mushroom*.

Practical No. 12, 13, 14 & 15 Preparation of Mushrooms Dish as per theory- Soup, Cutlet, Samosa, Pickles and curry (Any four).

**Course Code: BO-126**

**Course Title: Food Technology**

<b>Course Code: BO-126</b>	<b>Course Category: Open Elective Course (OE)</b>
<b>Course Title: Food Technology</b>	<b>Type: Theory</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> This course is intended to provide an introduction to <ol style="list-style-type: none"><li>1. To impart knowledge of various areas related to Food Science and Technology.</li><li>2. To enable the students to understand food composition and its physicochemical, and nutritional, aspects of food Science.</li><li>3. To familiarize the students with the processing and preservation techniques of food Products.</li><li>4. To emphasize the importance of food safety, food quality, food plant.</li><li>5. To enable the students to understand food processing technologies and products.</li><li>6. To learn and innovate the Ideal methods of food Preparation, Processing, Storage also to conserve the nutritive values of food products.</li><li>7. To maintain the quality and safety of food.</li></ol>	
<b>Course Outcomes:</b> <ol style="list-style-type: none"><li>1. Students will demonstrate knowledge of various properties of food and its application in food industry,</li><li>2. Students will understand the Concept of food processing, conventional and advanced methods of food preservation,</li><li>3. Students will learn Methods of packing, &amp; develop food products and for food industry.</li></ol>	

## **Course Content:**

**Unit 1:** Introduction to Food Science

**(07 L, 50 M)**

1.1. Different Kinds of Food Industries,

1.2. Components of Food Industries.

1.3. Scope of food processing and technology, Food constituents:

2.1. Carbohydrates, lipids, proteins, vitamins and minerals, water.

2.2. Nutritional and chemical properties of food constituents and their function.

**Unit 2: Introduction to Food Preservation Techniques. (07 L, 50 M)**

3.1. Define Pasteurization, Sterilization, Ultra High temperature, Blanching, etc.

3.2. Low-temperature preservation techniques: Cooling, Evaporation, refrigeration, and freezing.

3.2. Canning(definition, time-temperature combination and equipments),

3.3. Packaging (Introduction, Metal Containers, Glass Containers, Rigid Plastic Containers, Restorable Pouches).

**Unit 3: Food preservation Physical & Chemical Methods (07 L, 00 M)**

4.1. Definition of chemical preservatives and types.

4.2. Physical (Morphological) & Chemical Properties of Milietes.

4.3. Introduction to new techniques in preservation of food like High Pressure Processing, Ohmic heating, Pulse electric field processing, Irradiation Shelf Life, Packaging and Labeling etc.

**Unit 4: Basic introduction to unit operation in Food Processing: (09 L, 50 M)**

4.1. Define the term Cleaning, dry cleaning methods, wet cleaning methods,

4.2. Peeling,

4.3. Grading and sorting.

4.4. Food Products : Methods of Preparation of Jam, Jelly, Marmalade, Banana Ketchup

Recipe, Sun drying of Potatoes.

4.5 Drying and their importance in the foodprocessing.

**Reference Books:**

1. Food Science by Norman N Potter and Joseph H. Hotchkiss, CBS Publishers and Distributors.
2. Advanced Textbook on Food and Nutrition by Dr. M. Swaminathan Vol: I & II, The Bangalore Printing and Publishing Co. Ltd.
3. Food Science by Norman N Potter and Joseph H. Hotchkiss, CBS Publishers and Distributors.

4. Food Science by Norman N Potter and Joseph H. Hotchkiss, CBS Publishers and Distributors.
5. Advanced Textbook on Food and Nutrition by Dr. M. Swaminathan Vol: I & II, The Bangalore Printing and Publishing Co. Ltd.
6. Food Facts and Principles Many N. S. & Shadaksha Swamy M. New Age International Publishers.
7. Bawa. A.S, O.P Chauhan et al. Food Science. New India Publishing agency, 2013
8. Roday, S. Food Science, Oxford publication, 2011.
9. B. Srilakshmi, Food Science, New Age Publishers, 2002.
10. Meyer, Food Chemistry, New Age, 2004.
11. De Sukumar., Outlines of Dairy Technology, Oxford Uni Press, 2007.
12. KHAN M.R. Horticulture & Gardening, Nirali Publication, Pune, 1995.

**Course Code: BO-127**

**Course Title: Practical based on BO 126**

<b>Course Code: BO-127</b>	<b>Course Category: Skill Enhancement Course</b>
<b>Course Title: Practical based on BO 126</b>	<b>Type: Practical</b>
<b>Total Contact Hours: 30 (2/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> This course is intended to provide an introduction to 1. To impart knowledge of various areas related to Food Science and Technology. 2. To enable the students to understand food composition and its physicochemical, and nutritional, aspects of food Science. 3. To familiarize the students with the processing and preservation techniques of food Products. 4. To emphasize the importance of food safety, food quality, food plant. 5. To enable the students to understand food processing technologies and products. 6. To learn and innovate the Ideal methods of food Preparation, Processing, Storage also to conserve the nutritive values of food products.	
<b>Course Outcomes:</b> 1. Students will demonstrate knowledge of various properties of food and its application in food industry and practically 2. Students will understand the Concept of food processing, conventional and advanced methods of food preservation. 3. Students will learn Methods of packing, & develop food products and for food industry.	

### **List of Experiment:**

Practical-1 Preparation of Pickle

Practical-2 Preparation of Jam

Practical-3 Preparation of Jelly

Practical-4 Preparation of Marmalade

Bacterial-5 Sun drying of Potatoes

Practical-6 Banana Ketchup Recipe

Practical-7 Banana Sauce/ Banana Chips



Practical-8 Visit to food processing Unit from local area

Practical- 9 Visit to food processing Unit

Practical-10 Quality inspection of foods products; Shelf Life, Packaging and Labeling, Physical Properties (Morphological features)

Practical-11 Ripening of Banana Ethrel (Ethrel is available online at low cost )

Practical-12 To study the concept of Gluten formation of various flours.

Practical-13 Determination of Physical Properties of Cereal Grains.

Practical-14 Determination of Chemical Properties of Cereal Grains/Milletes

Practical-15 Preparation of Dried onion /garlic/ginger.

**NOTE:** There is no Practical course for food Technology as Mentioned in

CODE STRUCTURE Circulated

### **Reference Books:**

Fundamentals of Horticulture (Practical Manual): S.K. Pandey C.S. Pandey: Published by: Dean, College of Agriculture, Jabalpur Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur, Madhya Pradesh 482004 Tele-fax: 0761- 2681236; web: [www.jnkvv.org](http://www.jnkvv.org)

**Course Code: BO-128**

**Course Title: Plant for Human Nutrition**

<b>Course Code: BO-128</b>	<b>Course Category: Skill Enhancement Course</b>
<b>Course Title: Plant for Human Nutrition</b>	<b>Type: Laboratory</b>
<b>Total Contact Hours: 60 (4/week)</b>	<b>Course Credits: 02</b>
<b>College Assessment (CA) Marks: 20</b>	<b>University Assessment (UA): 30</b>
<b>Course Objectives:</b> 1) To know the role plants in human Nutrition. 2) To make aware the students about "Green Revolution in India". 3) To know importance of plants & plant products 4) To study chemical contents of the plant products in nutritional point of view. 5) To know about utility of plant resources	
<b>Course Outcomes:</b> 1. Provide identification technique of plants used for human nutrition. 2. Understand the types of plant species and its interdisciplinary approaches. 3. Provide lab-based training for students in nutritionally used plant species. 4. Recognise plants for their nutritional, medicinal, economic importance for human.	

## **Course Content:**

**Unit1:** Introduction plants for human nutrition

**(10 L, 50 M)**

**1.1** Introduction, scope & importance

**1.2** Role of plant in human nutrition

**1.3** Green revolution in India.

### **Source of Food plants: Millets and Pulses**

**1.4** Millets: Botanical characteristics, Importance, chemical contents of grains and uses of: i) Sorghum, ii) Bajara, iii) Nagali

**1.5** Pulses: Botanical characteristics, Importance, Chemical contents of seed and uses of: i) Pigeon pea and ii) Chick pea.

**Unit 2: Source of Food plants: Vegetables and Fruits** (07 L, 00 M)

**2.1 :** Vegetables: Botanical characteristics, Importance, Chemical contents and uses of: i.) Spinach, ii.) Moringa oleifera (Shewaga) iii.) Brinjal.

**2.2 :** Fruits: Botanical source, chemical contents and uses of:  
i) Banana ii) Guava iii) Mango

**Unit 3: Plants of nutritional and commercial value:** (07 L, 50 M)

**3.1 :** Introduction of nutritionally and commercially important plants.

**3.2 :** Starch: i) Definition, Chemistry and characteristic, ii) Types of starch grains, iii) Manufacture of starch from Maize and iv) By products of starch.

**3.3 :** Sugars: i) Definition, Chemistry and characteristics, ii) Plant sources- Cane sugar, iii) Manufacture of Cane sugar, iv) By-products of sugar industry.

**3.4 :** Oils: i) Definition, chemistry and characteristics, ii) Types, iii) Fixed oil: Soybean and Ground nut oil- Sources and process,

**Unit4: Food adjuncts:** (06 L, 50 M)

**5.1 :** Spices: Importance, Botanical sources, Characteristic, Active principles and uses of following i) Turmeric, ii) Clove, iii) Capsicum

**5.2 :** Condiments: Importance Botanical source chemical contents, plant parts used and uses of: i) Coriander, ii) Cardamom, iii) Cinnamon.

**5.3 :** Beverages: Importance, Botanical sources, Characteristic, Active principles and uses of following a) Tea, b) Coffee.

**Reference Books:**

1. Aiyer, A.K.Y.N. (1954) Field Crops in India. The Bangalore Printing & Publishing Company Bangalore.
2. Bendre, Ashok and Ashok Kumar (1998-1999) Economic Botany for Under Graduate Students, Rastogi Publications, Meerut, India.
3. Hill, A.F. (1952), Economic Botany (2nd Ed.) Mc Graw Hill Company Pvt.Ltd. New York.
4. Kochhar. S.L. (1998) Economic Botany in The Tropics (2nd Ed) Macmillan India Ltd, Delhi, Mumbai.
5. Pande B.P. (2006) Botany for degree Students, S.Chand & Co.Ltd. Ramnagar New Delhi.110055.

6. Pandey, S.N. and Archana (1996) Economic Botany, Vikas Publishing House, New Delhi.
7. Parthasarathy, S.V. (1972) Sugar Cane In India, K.C.P.Ltd., Madras.
8. Patil D.A. and D.A. Dhale (2012) Spices And Condiments: Origin, History & Applications. Daya Publishing House, Delhi, India.
9. Patil, D.A. (2010) Medicinal Plants: History, Culture And Usage. Mangalam Publishers & Distributors, Delhi, India.
10. Patil, M.V. and D.A. Patil (2013) Herbal Materia Medica of Maharashtra. Daya Publishing House, Division of Astral International P.Ltd., New Delhi, India.
11. Pruthi, J.S. (1976) Spices and Condiments, National Book Trust, Delhi.
12. Sambamurthy, A.V.S.S. and Subramanyam, N.S. (1989). A Textbook of Economic Botany, Wiley Eastern Ltd. New Delhi.
13. Sharma, B. K. and P. B. Awasthi (1984). Economic Botany, Prakash Book Depot, Bareilly.
14. Chattopadhyay P. K. (2022), Handbook on maize (corn) processing and manufacture of maize products; NIIR project consultancy services.