



# **Savitribai Phule Pune University**

*(Formerly University of Pune)*

**Three Year B.Sc. Degree Program in Botany**

**(Faculty of Science & Technology)**

**F.Y.B.Sc. (Botany)**

**Choice Based Credit System (CBCS) Syllabus**

**To be implemented from Academic Year 2019-2020**

## Title of the Course: B. Sc. (Botany)

### Preamble:

The syllabus includes basic as well as advanced concepts in the plant sciences from first year to the third year shall inspire the students for pursuing higher studies in Botany and for becoming an entrepreneur and also enable students to get employed in the Botany subject based industries.

### Introduction: Objectives:

1. This course is to ensure that you can achieve an up-to-date level of understanding of plant science.
2. Botany is a branch of biological science that focuses on the study of plants and how they survive and interact with other living and nonliving things in the environment. At the undergraduate and graduate levels, the curriculum for a botany degree typically consists of lecture-based courses, labs and field research.
3. A three-year bachelor's degree program in botany provides the foundation for prospective botanists to pursue a graduate level education or find an entry-level career.
4. To highlight the potential of these studies to become an entrepreneur.

### Program Outcome:

1. **Knowledge and understanding** of the range of plant diversity in terms of structure, function and environmental relationships. The role of plants in the functioning of the ecosystem. A selection of more specialized, optional topics. Statistics as applied to biological data.
2. **Intellectual skills** – able to think logically and organize tasks into a structured form. Assimilate knowledge and ideas based on wide reading and through the internet.
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. a. Interpreting plant morphology and anatomy. b. Plant identification. c. Vegetation analysis techniques. d. A range of physiochemical analyses of plant materials in the context of plant physiology and biochemistry. e. Analyze data using appropriate statistical methods and computer packages. f. Plant pathology to be added for sharing of field and lab data abstained.

4. **Scientific Knowledge:** Apply the knowledge of basic science, life sciences and fundamental process of plants to study and analyze any plant form.
5. **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.
6. **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
7. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern instruments and equipments for Biochemical estimation, Molecular Biology, Biotechnology, Plant Tissue culture experiments, cellular and physiological activities of plants with an understanding of the application and limitations.
8. **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.
9. **Ethics:** Apply ethical principles and commit to environmental ethics and responsibilities and norms of the biodiversity conservation.

**Structure of Course:**

<b>Structure B.Sc. Botany syllabus</b>					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	BO 231	Botany Theory Paper 1	2
			BO 232	Botany Theory Paper 2	2
			BO 233	Botany Practical Paper	2
	4	Compulsory Course	BO 241	Botany Theory Paper 1	2
			BO 242	Botany Theory Paper 2	2
			BO 243	Botany Practical Paper	2
3	5	Discipline Specific Elective Course	BO 351	Botany Theory Paper 1	2
			BO 352	Botany Theory Paper 2	2
			BO 353	Botany Theory Paper 3	2
			BO 354	Botany Theory Paper 4	2
			BO 355	Botany Theory Paper 5	2
			BO 356	Botany Theory Paper 6	2
			BO 357	Botany Practical Paper 1	2
			BO 358	Botany Practical Paper 2	2
			BO 359	Botany Practical Paper 3	2
	Skill Enhancement course	BO 3510	Botany Theory Paper 7	2	
		BO 3511	Botany Theory Paper 8	2	
3	6	Discipline Specific Elective Course	BO 361	Botany Theory Paper 1	2
			BO 361	Botany Theory Paper 2	2
			BO 362	Botany Theory Paper 3	2
			BO 363	Botany Theory Paper 4	2
			BO 364	Botany Theory Paper 5	2
			BO 365	Botany Theory Paper 6	2
			BO 366	Botany Practical Paper 1	2
			BO 367	Botany Practical Paper 2	2
			BO 368	Botany Practical Paper 3	2
	Skill Enhancement course	BO 3610	Botany Theory Paper 7	2	
		BO 3611	Botany Theory Paper 8	2	

**Equivalence of Previous Syllabus:**

<b>Old Course (2013 Pattern)</b>	<b>New Course (2019 CBCS Pattern)</b>
Fundamentals of Botany: PAPER – I Term- I: Plant Diversity	BO 111 Plant life and utilization I
Botany Theory Paper II Term I – Industrial Botany	BO 112 Plant morphology and Anatomy
Fundamentals of Botany: PAPER - I Term- II: Morphology and Anatomy	BO 121 Plant life and utilization II
Botany Theory Paper II Term- II – Industrial Botany	BO 122 Principles of plant science
F. Y. B. Sc. Botany Practical Paper - III based on Theory Paper I and Paper II	BO 113 Practical based on BO 111 & BO 112 and BO 123 Practical based on BO 121 & BO 122

**SEMESTER-I: PAPER-I****BO-111: PLANT LIFE AND UTILIZATION I (30 Lectures)****CREDIT-I****15 Lectures (15 Hours)****1. INTRODUCTION****3 L**

General outline of plant kingdom (**Lower Cryptogams**: Thallophytes- Algae, Fungi & Lichens; **Higher Cryptogams**: Bryophytes and Pteridophytes; **Phanerogams**: Gymnosperms and Angiosperms- Dicotyledons and Monocotyledons). Distinguishing characters of these groups and mention few common examples from each.

**2. ALGAE****9 L**

2.1: Introduction

2.2: General Characters

2.3: Classification (Bold and Wynne 1978) up to classes with reasons

2.4: Life Cycle of *Spirogyra* w.r.t. Habit, Habitat, Structure of thallus, structure of typical cell, Reproduction- Vegetative, Asexual and Sexual, systematic position with reasons

2.5: Utilization of Algae in Biofuel Industry, Agriculture, Pharmaceuticals, Food and Fodder

**3. LICHENS****3 L**

3.1: Introduction

3.2: General Characters

3.3: Nature of Association, forms- Crustose, Foliose and Fruticose.

3.4: Utilization of lichens.

**CREDIT-II****15 Lectures (15 Hours)****4. FUNGI****9 L**

4.1: Introduction

4.2: General Characters

4.3: Classification (Ainsworth, 1973)

4.4: Life Cycle of Mushroom- *Agaricus bisporus* w.r.t. Habit, Habitat, Structure of thallus, Structure of Sporocarp, Structure of Gill, Reproduction- Asexual and sexual, Systematic position.

4.5: Utilization of Fungi in Industry, Agriculture, Food and Pharmaceuticals.

**5. BRYOPHYTES****6 L**

5.1: Introduction

5.2: General Characters

5.3: Classification (G.M. Smith 1955)

5.4: Life Cycle of *Riccia* w.r.t. Habit, habitat, external and internal structure of thallus, Reproduction- vegetative, asexual and sexual- Structure of sex organs, fertilization, structure of mature sporophyte, structure of spore, systematic position with reasons.

5.5: Utilization: Bryophytes as ecological indicators, agriculture, fuel, industry and medicine.

(Development of sex organs not expected for all the above mentioned life cycles).

**REFERENCES:**

1. Ainsworth, Sussman and Sparrow (1973). The Fungi. Vol. IV-A and IV-B. Academic Press.
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4. Dube, H.C. (1990). An Introduction to Fungi. Vikas Publishing House Pvt. Ltd., Delhi.
5. Krishnamurty, V. (2000). Algae of India and neighboring countries, Chlorophyta, Oxford and IBH, New Delhi.
6. Parihar, N.S. (1980). Bryophyta, An Introduction of Embryophyta. Vol. I. Central Book Distributors, Allahabad.
7. Puri, P. (1980). Bryophyta: Broad prospective. Atma Ram & Sons, Delhi.
8. Smith, G.M. (1971). Cryptogamic Botany. Vol. I: Algae & Fungi. Tata McGraw Hill Publishing Co., New Delhi.
9. Smith, G.M. (1971). Cryptogamic Botany. Vol. II: Bryophytes & Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi.
10. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Algae, S. Chand Publication.
11. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Fungi, S. Chand Publication.
12. Vashista, B.R., Sinha, A.K. and Singh, V.B. (2005). Botany for degree students- Bryophytes, S. Chand Publication.

**SEMESTER-I: PAPER-II****BO-112: PLANT MORPHOLOGY AND ANATOMY (30 Lectures)****CREDIT-I****15 Lectures (15 hours)****1. MORPHOLOGY:****2 L**

1.1: Introduction, definition, descriptive and interpretative morphology.

1.2: Importance in identification, nomenclature, classification, phylogeny and Plant breeding.

**2. MORPHOLOGY OF REPRODUCTIVE PARTS:****2.1: INFLORESCENCE:****3 L**

2.1.1 Introduction and definition

2.1.2 Types:

a) Racemose -Raceme, Spike, Spadix, Corymb, Umbel, Catkin and Capitulum.

b) Cymose -Solitary, Monochasial- Helicoid and scorpioid; Dichasial and Polychasial.

c) Special types -Verticillaster, Cyathium and Hypanthodium.

2.1.3 Significance

**2.2: FLOWER:****7 L**

2.2.1 Introduction and definition

2.2.2 Parts of a typical flower: Bract, Pedicel, Thalamus- forms, Perianth- Calyx and Corolla, Androecium and Gynoecium.

2.2.3 Symmetry: Actinomorphic and zygomorphic, Sexuality- Unisexual and bisexual, Insertion of floral whorls on thalamus- Hypogyny, Epigyny and perigyny, Merous condition-Trimerous, tetramerous and pentamerous.

2.2.4 Floral whorls:

a) **Calyx:** Nature- Polysepalous, Gamosepalous; Aestivation- types, Modifications of Calyx- Pappus, Petaloid and Spurred.b) **Corolla:** Forms of Corolla-

i) Polypetalous- Cruciform and Papilionaceous.

ii) Gamopetalous- Infundibuliform, Bilabiate, Tubular and Campanulate.

iii) Aestivation- types and significance.

c) **Perianth:** Nature- Polytepalous, Gamotepalous.d) **Androecium:** Structure of typical stamen, Variations- cohesion and adhesion.e) **Gynoecium:** Structure of typical carpel, number, position, cohesion and adhesion; placentation- types and significance.**2.3: FRUITS:****3 L**

2.3.1 Introduction and definition

2.3.2 Types of fruits:

a) **Simple:** Indehiscent - Achene, Cypsela, Nut and Caryopsis.

Dehiscent - Legume, Follicle and Capsule,

b) **Fleshy:** Drupe, Berry, Hesperidium and Pepo.c) **Aggregate:** Etaerio of Berries and Etaerio of Follicles.d) **Multiple fruits:** Syconus and Sorosis.



**CREDIT- II****15 Lectures (15 Hours)****3. ANATOMY:****2 L**

3.1 Introduction and definition

3.2 Importance in Taxonomy, Physiology, Ecological interpretations, Pharmacognosy and Wood identification.

**4. TYPES OF TISSUES:****8 L**

Outline with brief description, simple and complex tissues.

4.1: **Meristmatic tissues:** Meristem, characters and types based on origin, position and plane of division, functions.4.2: **Permanent tissues:** Simple tissues - parenchyma, collenchymas, chlorenchyma and sclerenchyma.4.3: **Complex/Vascular tissues:** Components of xylem and phloem, types of vascular bundles and functions.4.4: **Epidermal tissues:** Epidermis, structure of typical stomata, trichomes, motor cells; functions.**5. INTERNAL ORGANIZATION OF PRIMARY PLANT BODY:****5 L**

5.1: Internal structure of dicotyledon and monocotyledon root.

5.2: Internal structure of dicotyledon and monocotyledon stem.

5.3: Internal structure of dicotyledon and monocotyledon leaf.

**REFERENCES:**

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11. Pandey, B.P. (2009). A Text Book of Botany- Angiosperms. S. Chand and Co. Ltd. New Delhi.
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15. Singh, Gurucharan (2005). Systematics- Theory and Practice. Oxford IBH.
16. Sutaria, R.N.A. Text Book of Systematic Botany.
17. Tayal, M.S. (2012). Plant Anatomy. Rastogi Publications.

**BO 113: PRACTICALS BASED ON BO 111 & BO 112 (1.5 CREDITS)**

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|---|------|
| 1. Study of Life Cycle of <i>Spirogyra</i> .  | 1 P  |
| 2. Study of Life Cycle of <i>Agaricus</i> .   | 1 P  |
| 3. Study of Life Cycle of <i>Riccia</i>   | 1 P. |
| 4. Study of forms of Lichens- Crustose, Foliose and fruticose.  | 1 P  |
| 5. Study of Mushroom Cultivation.   | 1 P  |
| 6. One day visit to study Algae, Fungi, Bryophytes and Lichens.   | 1 P  |
| 7. Study of Inflorescence.  | 2 P  |
| a. Racemose: Raceme, Spike, Spadix, Catkin, Corymb, Umbel and Capitulum                                       |      |
| b. Cymose: Solitary cyme, Uniparous cyme: helicoid and scorpiod, Biparous cyme and Multiparous cyme.          |      |
| c. Special type: Verticillaster, Hypanthodium and Cyathium.   |      |
| 8. Study of flower with respect to Calyx, Corolla and Perianth, Androecium and Gynoecium.                     | 2 P  |
| 9. Study of fruits with suitable examples.  | 2 P  |
| a) Simple fruit: Dry: Achene, Cypsella and Legume; Fleshy: Berry and Drupe.                                   |      |
| b) Aggregate fruit: Etaerio of follicles and Etaerio of Berries.  |      |
| c) Multiple fruit: Syconus and Sorosis.   |      |
| 10. Study of internal primary structure of dicotyledonous root and stem e.g. Sunflower.                       | 1 P  |
| 11. Study of internal primary structure of monocotyledonous root and stem e.g. Maize.                         | 1 P  |
| 12. Study of internal primary structure of dicotyledonous and monocotyledonous leaf e.g. Sunflower and Maize. | 1 P  |

## SEMESTER-II: PAPER-I

### BO-121: PLANT LIFE AND UTILIZATION-II (30 Lectures)

#### CREDIT-I

**15 Lectures (15 hours)**

1. **INTRODUCTION:** Introduction to plant diversity- Pteridophytes, Gymnosperms and Angiosperms with reference to vascular plants. 2 L
2. **PTERIDOPHYTES:** General characters, Outline classification according to Sporne (1976) up to classes with reasons. Life cycle of *Nephrolepis* w.r.t. Habit, habitat, distribution, morphology, anatomy of stem and leaf, Reproduction – vegetative and sexual. 11 L
3. Utilization and economic importance of Pteridophytes. 2 L

#### CREDIT-II

**15 Lectures (15 hours)**

1. **GYMNOSPERMS:** General characters, Outline classification according to Sporne (1977) up to classes with reasons. Life cycle of *Cycas* w.r.t. Habit, Habitat, Distribution, Morphology and Anatomy of Stem, leaf and reproductive organs- Male cone, Microsporophyll, microspores and megasporophyll, megaspore; structure of seed; Utilization and economic importance of gymnosperms. 8 L
2. **ANGIOSPERMS:** General characters, Outline of classification of Bentham and Hooker's system up to series, comparative account of monocotyledons and dicotyledons. 4L
3. Utilization and economic importance of Angiosperms: In food, fodder, fibers, horticulture and medicines. 3L

#### REFERENCES:

1. Bendre, Ashok and Kumar, Ashok (1993). A Text Book of Practical Botany, Rastogy Publications, Meerut.
2. Chamberlain, C.J. (1934). Gymnosperms- Structure and Evolution. Chicago.
3. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms. Chicago.
4. Davis, P.H. and Heywood, V.H. (1963). Principles of Angiosperms taxonomy. Oliver and Boyd Publ. London.
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17. Vashishta, P.C., Sinha, A.R. and Kumar, Anil (2006). Gymnosperms. S. Chand and Comp. Ltd. New Delhi.
18. Vashista, B.R., Sinha A.K. and Kumar, A. (2008). Botany for degree students- Pteridophyta, S. Chand and Comp. Ltd. New Delhi.

**SEMESTER-II: PAPER-II****BO-122: PRINCIPLES OF PLANT SCIENCE (30 Lectures)****CREDIT-1: PLANT PHYSIOLOGY AND CELL BIOLOGY****15 Lectures (15 Hours)**

1. Introduction, definition and scope of plant physiology. 1 L
2. Diffusion – definition, factors affecting diffusion, importance of diffusion in plants, imbibition as a special type of diffusion. 1 L
3. Osmosis – definition, types of solutions (hypotonic, isotonic, hypertonic), endosmosis, exo-osmosis, osmotic pressure, turgor pressure, wall pressure, importance of osmosis in plants. 2 L
4. Plasmolysis – definition, mechanism and significance. 1 L
5. Plant growth and growth regulators – introduction, phases of growth, factors affecting growth, plant growth regulators – introduction, definition and their significance. 2 L
6. Structure of plant cell, differences between prokaryotic and eukaryotic cell. 1 L
7. Plant cell wall – components of primary cell wall, structure and functions. 1 L
8. Plasma membrane- bilayer and fluid mosaic model, components and functions 1 L
9. Ultrastructure and functions of chloroplast, mitochondria and endoplasmic reticulum. 2 L
10. Cell cycle in plants – phases of cell cycle (G<sub>1</sub>, M, G<sub>2</sub> and S), importance of cell cycle in plants, divisional stages of mitosis and meiosis. 3 L

**CREDIT-II: MOLECULAR BIOLOGY****(15 Lectures) 15 Hours**

1. Introduction and scope of molecular biology, central dogma of molecular biology. 2 L
2. Structure of DNA- Structure of nitrogen bases, nucleoside, nucleotide, Chargaff's rule, C value paradox. 2 L
3. Watson Crick model of DNA and its characteristic features, types of DNA (A, B and Z DNA). 3 L
4. Packing of DNA into chromosomes, types of chromosomes. 2 L
5. Structure and types of RNA. 3 L
6. DNA replication- Types of replication (conservative, semi-conservative and dispersive), bacterial DNA replication (Initiation, elongation and termination), enzymes involved, leading and lagging strands, Okazaki fragments. 3 L

**REFERENCES:**

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13. Watson, James D., Baker, Tania; Bell, Stephen P.; Alexander Gann; Levine, Michael and Lodwick, Richard (2008). Molecular Biology of the Gene. 6<sup>th</sup> Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA.
14. Weaver, R. (2011). Molecular Biology. 5<sup>th</sup> Edition, Publisher- McGraw Hill Science. USA.

### **BO 123: PRACTICALS BASED ON BO 121 & BO 122 (1.5 CREDITS)**

- |   |     |
|---|-----|
| 1. Study of life cycle of <i>Nephrolepis</i> .  | 1 P |
| 2. Study of life cycle of <i>Cycas</i> .  | 1 P |
| 3. Study of utilization and economic importance of Pteridophytes and Gymnosperms.   | 1 P |
| 4. Study of comparative account of Dicotyledonous and Monocotyledonous plants   | 1 P |
| 5. Study of utilization and economic importance of Angiosperms- food, fodder, fibers, horticulture and medicines.                               | 1 P |
| 6. One day visit to study diversity of vegetation.  | 2 P |
| 7. To observe characteristic features of prokaryotic and eukaryotic plant cell.   | 1 P |
| 8. Study of mitosis- preparation of slides using onion root tips to observe divisional stages.  | 1 P |
| 9. Study of meiosis- preparation of slides using <i>Tradescantia/ Rhoeo/ Maize / Onion</i> flower buds to observe divisional stages.            | 2 P |
| 10. Estimation of chlorophyll-a and chlorophyll-b by using suitable plant material.   | 1 P |
| 11. Plasmolysis- endosmosis, exosmosis, incipient plasmolysis using <i>Rhoeo</i> leaf peeling and Demonstration of Osmosis- curling experiment. | 1 P |
| 12. DNA extraction using banana / phenol chloroform method or any suitable method and checking purity of DNA by 260:280 ratio.                  | 2 P |