

F.Y.B.Sc. Botany



**MAHARASHTRA EDUCATION SOCIETY
ABASHEB GARWARE COLLEGE
(Autonomous)**

(AFFILIATED TO SAVITRIBAI PHULE PUNE UNIVERSITY)

**Three Year B.Sc. Degree Program in Botany
(Faculty of Science and Technology)**

**Syllabi under Autonomy
F.Y.B.Sc. (Botany)**

**Choice Based Credit System Syllabus
To be implemented from Academic Year 2022-2023**

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.

Program Outcome

1. To ensure that students can get latest level of knowledge of plant science.
2. To make the students aware of the curriculum for a botany degree that consists of lecture-based courses, laboratory work and outdoor / field activities.
3. To provide the groundwork for prospective botanists to pursue a graduate level education or find an entry-level career.
4. To highlight the potential of studies in plant sciences to become a capitalist.

Eligibility: XII standard pass with Biology**Structure of the Course: F.Y.B.Sc. (CBCS) BOTANY**

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures /Practical to be conducted
1	I	Compulsory	USBO-111	Plant Life & Utilization I	Theory	2	36
		Compulsory	USBO-112	Plant Morphology & Anatomy	Theory	2	36
		Compulsory	USBOP-113	Practicals based on USBO-111 &USBO-112	Practical	1.5	12 P
	II	Compulsory	USBO-121	Plant Life & Utilization II	Theory	2	36
		Compulsory	USBO-122	Principles of Plant science	Theory	2	36
		Compulsory	USBOP-123	Practicals based on USBO-121 &USBO-122	Practical	1.5	12 P

2	III	Compulsory	USBO- 231	Angiosperm Taxonomy & Anatomy	Theory	2	36
		Compulsory	USBO- 232	Embryology, Vegetable seed production & certification	Theory	2	36
		Compulsory	USBOP- 233	Practicals based on USBO- 211 &USBO-221	Practical	2	12 P
	IV	Compulsory	USBO-241	Plant Physiology	Theory	2	36
		Compulsory	USBO-242	Plant Biotechnology	Theory	2	36
		Compulsory	USBOP-243	Practicals based on USBO-212&USBO-222	Practical		12 P

Structure of the Course: T.Y.B.Sc. (CBCS) BOTANY

Year	Semester	Course Type	Course Code	Course Title	Remark	Credit	No. of Lectures /Practical to be conducted
3	V	Compulsory	USBO- 351	Algae and Fungi	Theory	2	36
		Compulsory	USBO- 352	Archegoniate	Theory	2	36
		Compulsory	USBO- 353	Spermatophyta and Paleobotany	Theory	2	36
		Compulsory	USBO- 354	Plant Ecology	Theory	2	36
		Compulsory	USBO- 355	Cell and Molecular Biology	Theory	2	36
		Compulsory	USBO- 356	Genetics & Plant Breeding	Theory	2	36
		Compulsory	USBOP- 357	Practicals based on USBO-351&USBO- 352	Practical	2	12 P
		Compulsory	USBOP- 358	Practicals based on USBO-353&USBO- 354	Practical	2	12 P
		Compulsory	USBOP- 359	Practicals based on USBO-355&USBO- 356	Practical	2	12 P
		Skill enhancement course	USBOSEC-3510	Medicinal & Economic Botany	Theory	2	36
		Skill enhancement course	USBOSEC-3511	Plant diversity & Computational Botany	Theory	2	36
	VI	Compulsory	USBO-361	Plant Physiology	Theory	2	36
		Compulsory	USBO-362	Phytochemistry	Theory	2	36
		Compulsory	USBO-363	Plant Pathology& Agri. weed management	Theory	2	36
		Compulsory	USBO-364	Evolution and Population genetics	Theory	2	36
		Compulsory	USBO-365	Advanced Plant Biotechnology, Plant tissue culture	Theory	2	36
		Compulsory	USBO-366	Polyhouse and Seed Technology	Theory	2	36
		Compulsory	USBOP-367	Practicals based on USBO-361&USBO-362	Practical	2	12 P
		Compulsory	USBOP-368	Practicals based onUSBO-363 &USBO-364	Practical	2	12 P
		Compulsory	USBOP-369	Practicals based on USBO-365 &USBO-366	Practical	2	12 P
Skill enhancement course		USBOSEC3610	Nursery and Landscape Gardening	Theory	2	36	
Skill enhancement course	USBOSEC3611	Biofertilisers & organic farming	Theory	2	36		

SEMESTER-I: PAPER-I**COURSE CODE & TITLE: USBO-111: PLANT LIFE AND UTILIZATION I (36 Lectures)
(2 credits)****Course Outcome:**

1. Acquaintance of the subject
2. Logical skills and practical abilities
3. Scientific domain Awareness and tricky investigation aptitudes
4. Strategic planning for questions
5. Current device usage
6. Sustainable survival of mankind

CREDIT-I**12 Lectures****1. INTRODUCTION****2 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**8 L**

2.1: Introduction

2.2: General Characters, recent trends in algal study (Algal conservation, important efforts of institutes in bioprospecting of algae and their ongoing efforts), range of thallus organization, pigments etc.

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**2L**

3.1: Introduction

3.2: General Characters

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

3.4: Utilization and ecology of lichens

3.5 Schools doing lichen research – ARI, NBRI, BSI, Allahabad University

CREDIT-II**24 Lectures****4. FUNGI****9L**

4.1: Introduction

4.2: General Characters,

4.3: Classification (Ainsworth, 1973), recent trends in fungal studies, (classification by IUCN)

4.4: Life Cycle of Mushroom- *Pleurotus sajorkaju* 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. Fungal ecology with respect to conservation, role of fungi in ecology, fungal herbivory (mycophagy)

5. BRYOPHYTES

7 L

5.1: Introduction

5.2: General Characters

5.3: Classification (G.M. Smith 1955), recent trends in bryophytes studies

5.4: Life Cycle of *Funaria* 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 of Bryophytes

6. Mushroom cultivation

8L

Mushroom cultivation: cultivation practices of *Agaricus* and Oyster mushroom, Identification and collection of wild edible mushrooms (Culinary uses) – edible mushrooms in western ghats, *Termitomyces* species, *Potabella*, uses of mushrooms, value added products, commercial significance.

REFERENCES:

1. Ainswarth, Sussman and Sparrow (1973). The Fungi. Vol. IV-A and IV-B. Academic Press.
2. Bilgrami, K.S. and Saha, L.C. (1992) A Textbook of Algae. CBS Publishers and Distributors, Delhi.
3. Gangulee, Das and Dutta (2002). College Botany. Vol. I, New Central Book Agency (P) Ltd.
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.

COURSE CODE & TITLE: USBO-112: PLANT MORPHOLOGY AND ANATOMY
(36 Lectures) 2credits

Course Outcome:

1. Acquaintance of the subject
2. Practical abilities and field experience
3. Scientific domain Awareness and tricky investigation aptitudes
4. Sustainable survival of mankind

CREDIT-I**18 Lectures****1. MORPHOLOGY:****2L**

- 1.1: Introduction, definition, descriptive and interpretative morphology.
 1.2: Importance in identification, nomenclature, classification, phylogeny and Plant breeding.

2. MORPHOLOGY OF VEGETATIVE PARTS:**3L**

- 2.1:** Vegetative morphology of Root, stem and Leaves – types and modifications

3. MORPHOLOGY OF REPRODUCTIVE PARTS:**3.2 INFLORESCENCE:****3 L**

- 3.1.1 Introduction and definition
 3.2.2 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.
 3.1.3 Significance

4.2: FLOWER:**7 L**

- 4.2.1 Introduction and definition
 4.2.2 Symmetry: Actinomorphic and zygomorphic, Sexuality- Unisexual and bisexual, Insertion of floral whorls on thalamus- Hypogyny, Epigyny and perigyny, Merous condition-Trimerous, tetramerous and pentamerous, Aestivation- types and significance.
 4.2.4 Floral whorls: a) Calyx - Polysepalous, Gamosepalous, modifications
 a) **Calyx** : Nature and modifications of calyx
 b) **Corolla**: Forms of Corolla
 c) **Perianth**: Nature of perianth
 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.
 f) Floral formula and floral diagram

- 5.3: FRUITS:** **3 L**
- 5.3.1 Introduction and definition
- 5.3.2 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**(18 lectures)****6. ANATOMY:**

- 6.1 Introduction and definition
- 6.2 Importance in Taxonomy, Physiology, Ecological interpretations, Pharmacongnosy and Wood identification. **3 L**

7. TYPES OF TISSUES:**7 L**

Outline with brief description, simple and complex tissues.

- 7.1: **Meristmatic tissues:** Meristem, characters and types based on origin, position and plane of division, functions.
- 7.2: **Permanent tissues:** Simple tissues - parenchyma, collenchymas, chlorenchyma and sclerenchyma.
- 7.3: **Complex/Vascular tissues:** Components of xylem and phloem, types of vascular bundles and functions.
- 7.4: **Epidermal tissues:** Epidermis, structure of typical stomata, trichomes, motor cells functions.
- 8. MEDICINAL PLANTS** – identification, propagation, research and extraction methods - *Tinospora*, Amla, Ginger, *Withania*, Adulsa **8L**

**COURSE CODE & TITLE: USBO 113: PRACTICALS BASED ON BO 111 & BO 112
(1.5 CREDITS) 12PRACTICALS**

- 1.- Study of Life Cycle of *Spirogyra*. **1P**
- 2.- Cultivation of *Pleurotus* **1P**
- 3.- Study of Life Cycle of *Funaria* **1P**
- 4.- Study of forms of Lichens- Crustose, Foliose and fruticose, T.S. of *Parmelia* **1P**
- 5.-One day visit to study Algae, Fungi, Bryophytes and Lichens. **1P**
6. Study of Inflorescence. **1P**
 - 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.
7. Study of flower with respect to Calyx, Corolla and Perianth, Androecium and Gynoecium, introduction of floral formula and floral diagram. **2P**
8. Study of fruits with suitable examples. **1P**
 - 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.
9. Phytochemical tests for medicinal plants. **1P**
10. Study of internal primary structures of dicotyledonous and monocotyledonous root and stem and leaf **2P**

REFERENCES:

1. Chandurkar, P.J. (1989). Plant Anatomy. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Dutta, A.C. (2003). Botany for Degree students. Oxford University Press, New Delhi.
3. Eames, J. and Mc. Daniels (1994). An Introduction to Plant Anatomy. Tata McGraw Hill Publishing Comp., New Delhi.
4. Esau, K. (1993). Plant Anatomy. Wiley Eastern Ltd. New Delhi.
5. Esau, K. (2006). Anatomy of seed plants. John Wiley and Sons, New York.
6. Fahn, A. (1974). Plant Anatomy. Pergamum Press Oxford.
7. Gangulee, Das and Dutta (2002). College Botany. Vol. I. New Central Book Agency, Kolkata.
8. Lawrence, G.H.M. (2012). Taxonomy of vascular Plants. Scientific Publishers (India) Jodhpur.
9. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
10. Pandey, B.P. (2007). Plant Anatomy. S. Chand and Co. Ltd. New Delhi.
11. Pandey, B.P. (2009). A Text Book of Botany- Angiosperms. S. Chand and Co. Ltd. New Delhi.
12. Radford, Albert E. (1986). Fundamentals of Plant Systematics. Publ. Harper and Row, New York.
13. Saxena, A.K. and Sarabhai, R.P. (1968). A Text Book of Botany. Vol. III. Ratan Prakashan mandir, Agra.
14. Sharma, O.P. (1993). Plant Taxonomy. 2nd Edition, McGraw Hill Education, New Delhi.
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.
18. Pharmacognosy – by Kokate, Gokhale and Purohit

SEMESTER-II**COURSE CODE & TITLE: USBO-121: PLANT LIFE AND UTILIZATION-II
(36 Lectures) 2 credits****Course Outcome:**

1. Acquaintance of the subject
2. Logical skills and practical abilities
3. Scientific domain Awareness and tricky investigation aptitudes
4. Strategic planning for questions
5. Current device usage
6. Sustainable survival of mankind

CREDIT-I**12 Lectures**

1. **INTRODUCTION:** Introduction to plant diversity- Pteridophytes, Gymnosperms and Angiosperms with reference to vascular plants, comparative analysis for these groups – recent trends in classification of groups - **3 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.- **8 L**
3. Utilization and economic importance of Pteridophytes.- **1 L**

CREDIT-II-**24 Lectures**

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:**
 - a. General characters, Outline of classification of Bentham and Hooker's system up to series, comparative account of monocotyledons and dicotyledons. Principles of APG 1, background for APG, brief review of various versions of APG - **5 L**
 - b. Utilization and economic importance of Angiosperms: In food, fodder, fibers, horticulture and medicines.- **3 L**
 - c. Introduction to plants used in Gardening and Landscaping – What is soft-scape, elements of soft-scape – borders, hedges, separators, screens, ornamentals with examples, trees, herbs, shrubs, climbers used in landscaping and gardening **8L**

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.
5. Dutta, S.C. (1988). Systematic Botany. Wiley Eastern Ltd., New Delhi.
6. Eames, E.J. (1983). Morphology of Vascular Plants. Standard University Press.
7. Gangulee and Kar (2006). College Botany. New Central Book Agency (P.) Ltd. Kolkata.
8. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
9. Parihar, N.S. (1976). Biology and Morphology of Pteridophytes. Central Book Depot.
10. Rashid, A. (1999). An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
11. Sharma, O.P. (1990). Text Book of Pteridophyta. McMillan India Ltd. Delhi.
12. Singh, V. and Jain, D.K. (2010). Taxonomy of Angiosperms. Rastogy Publications, Meerut.
13. Gardening in India by T K Bose and D. Mukherjee

**COURSE CODE & TITLE: USBO-122: PRINCIPLES OF PLANT SCIENCE
(36 Lectures) 2 credits**

Course Outcome:

1. Acquaintance of the subject
2. Logical skills and practical abilities
3. Scientific domain Awareness and tricky investigation aptitudes
4. Latest updates and research knowledge

CREDIT-I: PLANT PHYSIOLOGY AND CELL BIOLOGY **18 Lectures**

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, exosmosis, osmotic pressure, turgor pressure, wall pressure, importance of osmosis in plants.- **4 L**
4. Plasmolysis – definition, mechanism and significance. **1L**
5. Plant growth – introduction, phases of growth, factors affecting growth **1L**
6. Plant cell wall – components of primary cell wall, structure and functions, secondary cellwall **4 L**
7. Plasma membrane- bilayer and fluid mosaic model, components and functions **1 L**
8. Ultrastructure and functions of chloroplast, mitochondria and endoplasmic reticulum, nucleus. **4L**
9. Cell cycle in plants – phases of cell cycle (G₁, M, G₂ and S), importance of cell cycle in plants **1 L**

CREDIT-II: MOLECULAR BIOLOGY **(18 Lectures)**

1. Introduction and scope of molecular biology, central dogma of molecular biology. **1L**
2. Structure of DNA- Structure of nitrogen bases, nucleoside, nucleotide, Chargaff's rule, C value paradox. **1 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. **2 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**
7. Wine Technology – Strains used, substrates, fermentation methods, filtration and purification, determination of alcohol, commercialization **6 L**

REFERENCES:

1. Devlin, R.M. (1983). Fundamentals of Plant Physiology. Mc. Millan, New York.
2. Dutta, A.C. (2000). A Class Book of Botany. Oxford University Press, UK.
3. Hopkins, William G. (1995). Introduction to Plant Physiology. Publ. John Wiley and Sons, Inc.
4. Lewin, Benjamin (2011). Genes. X Jones and Bartlett.
5. Lincoln, Taiz and Eduardo, Zeiger (2010). Plant Physiology. 5th Edition. Sinauer Associates, Inc. Publishers. Sunderland, USA.
6. Opik, Helgi, Rolfe, Stephen A. and Willis, Arthur J. (2005). The Physiology of Flowering Plants. Cambridge University Press, UK.
7. Pal, J.K. and Ghaskadbi, Saroj (2009). Fundamentals of Molecular Biology. Oxford University Press. India.
8. Pandey, S.N. and Sinha, B.K. (2014). Plant Physiology. Vikas Publishing House Pvt. Ltd., India.
9. Salisbury, F.B. and Ross, C.B. (2005). Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont California, USA.
10. Watson, James D., Baker, Tania; Bell, Stephen P.; Alexander Gann; Levine, Michael and Lodwick, Richard (2008). Molecular Biology of the Gene. 6th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA.
11. Weaver, R. (2011). Molecular Biology. 5th Edition, Publisher- McGraw Hill Science. USA.
12. The beverage manager's guide to wines, beers and Spirits by Pearson (4th edition)

**COURSE CODE & TITLE: USBO 123: PRACTICALS BASED ON BO 121 & BO 122
(1.5 CREDITS) 12 PRACTICALS**

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| 1. Study of life cycle of <i>Nephrolepis</i> . | 1P |
| 2. Study of life cycle of <i>Cycas</i> . | 1P |
| 3. Study of utilization and economic importance of Angiosperms- food, fodder, fibers, - horticulture and medicines.- | 1P. |
| 4. One day visit to study diversity of vegetation. | 2P |
| 5. Estimation of chlorophyll-a and chlorophyll-b by using suitable plant material. | 1P |
| 6. Plasmolysis- endosmosis, exosmosis, incipient plasmolysis using <i>Rhoeo</i> leaf peeling | 1P |
| 7. Study of Osmosis- curling experiment. - | 1P |
| 8. DNA extraction using banana / phenol chloroform method or any suitable method and checking purity of DNA by 260:280 ratio.- | 2P |
| 9. Demonstration of plants species used in gardening and landscape designing | 1P |
| 10. Wine preparation and estimation of alcohol | 2P |