

**Rayat Shikshan Sanstha's  
Yashwantrao Chavan Institute of Science,  
Satara  
(Autonomous)**

**Syllabus Under Autonomy  
For  
B. Sc. I (Botany)**

**Academic Year 2018 – 2019**

Rayat Shikshan Sanstha's

## **Yashwantrao Chavan Institute of Science, Satara**

### **Syllabus for Bachelor of Science (B. Sc.) Part – I**

1. **TITLE:** Botany

2. **YEAR OF IMPLEMENTATION:** 2018 – 2019

3. **PREAMBLE:**

The B. Sc. Botany course under autonomy will be effective from the academic year 2018 – 2019. It has been prepared keeping in view the unique requirements of B. Sc. Botany students. The contents have been drawn up to accommodate the widening horizons of the discipline of biological sciences. The emphasis is to provide students the latest information along with due weightage to the concepts of classical botany so that they are able to understand and appreciate the current interdisciplinary approaches in the study of plant sciences and its role in societal development. The course content also lists new practical exercises so the students gets a hands on experience of the latest techniques that are currently in use. The course will also inspire students to pursue higher studies in botany, for becoming an entrepreneur and enable students to get employed in plant based industries.

4. **GENERAL OBJECTIVES OF THE COURSE:**

1. To impart the knowledge of science is the basic objective of education.
2. To develop scientific attitude among the students and to make the students open minded, critical and curious.
3. To develop skill in practical work, experiments and laboratory materials.
4. To understand scientific terms, concepts, facts, phenomenon and their relationships.
5. To make the students aware of natural resource and environment.
6. To enable the students to acquire knowledge of plants and related subjects so as to understand nature and environment in the benefit of human beings.
7. To develop ability for the application of acquired knowledge to improve agriculture and related fields to make the country self-reliant.

5. **DURATION:** 01 year

6. **PATTERN:** CBCS Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

1) FIRST SEMESTER (NO. OF PAPERS – 02)

Sr. No.	Subject Title	Theory					Practical	
		Paper No. & Paper Code	Title of Paper	No. of lectures per week	Credits		No. of lectures Per week	Credits
1.	Botany	Paper – I: BBT 101	Plant Diversity I (Algae, Fungi, Lichens and Bryophytes)	5	4	Practical Paper – I : BBP103	4	2
		Paper – II: BBT102	Industrial Botany					

2) SECOND SEMESTER (NO. OF PAPERS – 02)

Sr. No.	Subject Title	Theory					Practical	
		Paper No. & Paper Code	Title of Paper	No. of lectures per week	Credits		No. of lectures Per week	Credits
1.	Botany	Paper-III: BBT 201	Plant Diversity II (Pteridophytes, Gymnosperms, Angiosperms and Palaeobotany)	5	4	Practical Paper – II : BBP 203	4	2
		Paper – IV: BBT 202	Fundamental Botany (Morphology, Anatomy and Embryology)					

2) Structure and titles of papers of B. Sc. Course

**B. Sc. I Semester I**

Paper I: Plant Diversity I (Algae, Fungi, Lichens and Bryophytes)

Paper II: Industrial Botany

Botany Practical I: Practical's based on Theory Paper I and II

**B. Sc. I Semester II**

Paper III: Plant Diversity II (Pteridophytes, Gymnosperms, Angiosperms and Palaeobotany)

Paper IV: Fundamental Botany (Morphology, Anatomy and Embryology)

Botany Practical II: Practical's based on Theory Paper III and IV

3) OTHER FEATURES:

A) LIBRARY:

Reference books, Text books, Journals, Periodicals available in Institute and Departmental Library. (Separate reference lists are attached along with the respective course syllabus)

B) SPECIFIC EQUIPMENTS:

a) Computer, LCD projector, Visualizer, Smart Board

b) Laboratory Equipments:

1. Microscope with digital camera
2. Digital weighing balance
3. pH meter
4. Microtome
5. Autoclave
6. Hot Air Oven
7. Incubator
8. Refrigerator

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**Syllabus introduced from June 2018**

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**Bachelor of Science (B. Sc.) Part – I: Botany**

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**Semester I**

**Theory Paper I (BBT 101) Plant Diversity I (Algae, Fungi, Lichens and Bryophytes)**

**Learning Objectives:**

1. To impart the basic knowledge of different plant groups.
2. To impart the knowledge of classical taxonomy.

**Unit I Introduction to Plant Kingdom and Algae (09)**

Systems of classification (Two, Three and Five kingdom systems), General outline of plant kingdom.

General Characters, Economic importance, Morphology and life cycle pattern (excluding developmental stages) of *Nostoc* and *Spirogyra*.

**Unit II Fungi (09)**

General Characters, Economic importance, Morphology and life cycle pattern (excluding developmental stages) of *Mucor* and *Penicillium*.

**Unit III Lichens (09)**

General characters, Economic importance, Types of Lichens on the basis of thallus morphology, Methods of reproduction.

**Unit IV Bryophytes (09)**

General characters, Economic importance, Morphology, anatomy and life cycle pattern (excluding developmental stages) of *Riccia* and *Funaria* with Alteration of Generations.

**References:**

Unit 1:

1. Kumar HD (1990) Introductory Phycology. East Western Press, New Delhi.

2. Sharma OP (1992) Textbook of Thallophytes. McGraw Hill Pub. Co.
3. Smith GM (1971) Cryptogamic Botany. Vol. I Algae and Fungi. Tata McGraw Hill Publishing Co. New Delhi.
4. Vashishtha BR (1976) Botany for Degree Students Part I Algae. S. Chand and Company, New Delhi.

Unit 2:

1. Ainsworth GG and AS Sussman, The Fungi Vols. I, II, III, IV- A and IV-B
2. Alexopoulos CJ (1960) Introductory Mycology
3. Dube HC, An Introduction to Fungi
4. Gangulee HS, Das and Datta (1992) College Botany Vol. I, New Central Book Agency (P) Ltd.
5. Gangulee HS and Kar AK (1992) College Botany Vol. II, New Central Book Agency (P) Ltd.
6. Sharma OO (1989) Textbook of Fungi
7. Vashistha BR and Sinha AK, Botany for degree students – fungi

Unit 3:

1. Awasthi DD (2000) A handbook of Lichens
2. Dube HC (1990) An Introduction to Fungi, Vikas Publishing House Pvt. Ltd., Delhi
3. Gangulee HS, Das and Datta (1992) College Botany Vol. I, New Central Book Agency (P) Ltd.
4. Gangulee HS and Kar AK (1992) College Botany Vol. II, New Central Book Agency (P) Ltd.
5. Sharma OP (1992) Textbook of Thallophytes. McGraw Hill Pub. Co.
6. Sharma PD (1991) The Fungi. Rastogi and Company, Meerut.

Unit 4:

1. Kashyap SR (1929) Liverworts of Western Himalayas and the Punjab Plains Part I and II
2. Parihar NS (1962) Bryophyta. Central Book Depot, Allahabad
3. Smith GM (1971) Cryptogamic Botany. Vol. II Tata McGraw Hill Publishing Co. New Delhi.
4. Watson EV (1971) The structure and life of Bryophytes. Hutchinson Press, London

**Learning Outcomes:**

1. The students should be able to explain features and uses of lower cryptogams.
2. The students should be able to define concepts regarding lower cryptogams.
3. The students should be able to write answers and brief notes about plant diversity of lower cryptogams.

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**Bachelor of Science (B. Sc.) Part – I: Botany**

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**Semester I**

**Theory Paper II (BBT102) Industrial Botany**

**Learning Objectives**

1. To impart the knowledge of role of plants in human welfare.
2. To make the students aware of the industrial applications of plant resources.

**Unit I Utilization of Plants (09)**

Plant resources utilization: Introduction, Food, fodder, fibers, medicines, timber, dyes, gum, tannins (Two examples of each resource), Relevant industries associated with above plant resources.

Industrial Mycology: Important genera of fungi used in various industries and their products [*Penicillium*, *Aspergillus* and *Saccharomyces* (yeast)], Mushroom cultivation: resources, cultivation practices of Oyster mushroom (*Pleurotus* spp.), uses of mushrooms, value added products.

**Unit II Bio-Fertilizers and Bio-Control (09)**

Bio-fertilizers: Concept and need, Types of bio-fertilizers, Nitrogen fixing biofertilizer: *Azotobacter*, *Rhizobium*, BGA (*Nostoc*, *Anabaena*), *Azolla*, Phosphorus solubilizing bacteria and Mycorrhiza, Potash mobilising bacteria.

Bio-control: Introduction, sources and advantages.

Important commercial products – Source, preparation and uses of Pyrethrins, Azadirachtin, *Trichoderma*, *Trichogramma*.

**Unit III Plant Pharmaceutical Industry (09)**

Concept and advantages, Types of pharmaceutical products: Churna, Asava and Arishta, Drug plants with reference to botanical source, active principles and medicinal uses of *Adathoda*, *Tinospora* and *Asparagus*.

Manufacture of Churna (*Triphala churna*), Arishta (Ashokarishta) and Asava (Kumariasava).



Concept of nutraceuticals and cosmeceuticals.

Commercial significance of Amla and Aloe.

#### **Unit IV Horticulture**

Introduction, Nursery Management: Concept, infrastructure required and types of nurseries

Propagation methods: Seed propagation, Vegetative propagation – natural propagation and artificial propagation (Cutting: Stem; Layering: Air layering; Grafting: Stone grafting; Budding : T-budding), Greenhouse technology: Principle (site selection, structure material, covering material, temperature and humidity control), structure of greenhouse, Types of greenhouses, Floriculture Industry: Introduction, Cultivation practices, harvesting and marketing of Rose and Gerbera.

#### **References:**

Unit 1:

1. Dube HC (1990) An Introduction to Fungi, Vikas Publishing House Pvt. Ltd., Delhi
2. Kochar SL (1998) Economic Botany in Tropics, 2<sup>nd</sup> Edition, McMillan India Ltd., New Delhi
3. Saman BC and Sharma VP (2005) Mushroom Cultivation, Processing and Uses, Agrobios, India
4. Sambamurthy AVSS and Subramanyam NS (1998) Textbook of Economic Botany, Wiley Eastern Ltd., New Delhi
5. Sharma OP (1996) Hill's Economic Botany, Tata McGraw Hill Publishing Company Ltd., New Delhi.
6. Simpson BB and Conner-Ogorzaly M (1986) Economic Botany – Plants in Our World, McGraw Hill, New York.

Unit 2:

1. Gupta MK (2007) Handbook of organic farming and biofertilizers, ABD Publisher, Jaipur
2. Murlidharan H, Sheshadri S, Biofertilizer (Phosphobacteria), Shri AMM Murugappa Chettiar Research Center, Taramani, Chennai.
3. Sadashivam K (2002) Biotechnology of biofertilizers, Springer Science and Business Media, India

4. Tilak KVBR, Pal KK, Dey R (2010) Microbes for sustainable agriculture, IK International Publishing House, New Delhi

Unit 3:

1. Maheshwari JK, Kunkel G, Bhandari MM, Duke J (1993) Ethnobotany in India. Scientific Publishers. Jodhpur, Rajasthan.
2. Deshmukh LP (2013) Medicinal Plants of India. Oxford Book Co., New Delhi
3. Bogers RJ, Craker LE, Lange D (2006) Medicinal and Aromatic Plants: Agricultural, Commercial, Ecological, Legal, Pharmacological and social aspects. Springer
4. Hoffmann F, Manning M (2009) Herbal Medicine and Botanical Medical Aids. Viva Books. New Delhi.
5. Drury CH (2006) Ayurvedic Useful Plants in India. Asiatic Publishing House, New Delhi.
6. Ambasta SP (1986) Useful Plants of India. CSIR, Delhi.
7. Pal DC, Jain SK (1998) Tribal medicine. Naya Prakash Publication, New Delhi
8. Nadkarni KM (2002) Indian Materia Medica Vol. I and II. Popular Prakashan, Mumbai
9. Wallis TE (1985) Textbook of Pharmacognosy. CBS Publishers and Distributors, New Delhi
10. Roseline A (2011) Pharmacognosy. MJP Publishers, New Delhi.
11. Chowdhary V (2014) Fundamentals of food processing, packaging, labeling and marketing. Anmol Publications, Pune

Unit 4:

1. Singh, S.P., Advances in horticulture and forestry [Call Number : 635.9/SIN]
2. Prasad, Surendra, Agros dictionary of horticulture [Call Number : 635/PRA]
3. Genin Andre, Application of botany in horticulture [Call Number : 582.15/GEN]
4. Sanders, T.W., Encyclopedic dictionary of horticulture [Call Number : 635.9/SAN]
5. Edmond, J.B., Senn, T.L., Fundamentals of horticulture [Call Number : 635/EDM/SEN]
6. Dhote, A.K., Horticulture [Call Number : 634/DHO]
7. Sheela.V.L., Horticulture [Call Number : 635/SHE]
8. Kaul, G.L., Horticulture crop in India [Call Number : 635/KAU]
9. Vidalie, H., Auge R. Beauchesne, G., In Vitro Culture and Its Applications In Horticulture [Call Number : 574.82 VID]

10. Arora, J. S., Introductory ornamental horticulture [Call Number : 635.9/ARO]
11. Saini, Laboratory Manual Of Analytical Techniques in Horticulture [Call Number : 635/SAI]
12. Rao, K. Manibhushan, Textbook of horticulture [Call Number : 635/RAO]

**Learning Outcomes:**

1. The students should be able to explain the role of plants in human welfare.
2. The students should be able to define concepts regarding industrial applications of plant resources.
3. The students should be able to write answers and brief notes about the role of plants in economic development of society.

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**Syllabus introduced from June 2018**

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**Bachelor of Science (B. Sc.) Part – I: Botany**

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**Semester I**

**Practical Paper I (BBP103) Practicals based on Theory Paper I and II**

1. Study of algae through two representative members *Nostoc* and *Spirogyra*.
2. Study of fungi through two representative members *Mucor* and *Penicillium*.
3. Study of Types of lichens (based on morphology).
4. Study of bryophytes (liverworts) through representative member *Riccia*.
5. Study of bryophytes (mosses) through representative member *Funaria*.
6. Study of plant resources in industries: food, fodder, fiber, medicine, timber and gum (Two example of each)
7. Study of types of Bio-fertilizers: *Rhizobium*, *Azotobacter*, BGA, *Azolla*.
8. Cultivation of *Oyster* mushroom: Demonstration of various stages.
9. Study of vegetative plant propagation: tubers, bulbs, rhizomes, corms, suckers and runners.
10. Study of artificial plant propagation: stem cutting, Air Layering, Approach grafting and T-budding.
11. Field visit and tour report.

**Learning Outcome:**

- 1-5. The student shall know habit, morphology, structure and phases of the plant form studied.
6. The student will be able to know about the plants and their specific parts used for different industries.
7. The student shall know about the constitution, manufacture, mode of action and application of biofertilizers.
8. The student shall learn practically the various stages involved in mushroom cultivation.
9. The student shall learn and see the morphology and anatomy of the different vegetative propagation structures in plants.

10. The student shall be given hands on practical knowledge of the basic techniques of artificial plant propagation.

11. The student should undertake field visit, short trips and be able to submit an account of it in the form of report.

**Books Recommended:**

1. Bendre A (2010) Practical Botany, Rastogi Publications
2. Pande BP, Modern Practical Botany, Vol. I, S Chand Publishers
3. Pande BP, Modern Practical Botany, Vol. II, S Chand Publishers
4. Wallis CJ (1966) Practical Botany for Advanced Level and Intermediate Students (5<sup>th</sup> Ed.), William Heinemann Medical Books Ltd.

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**Bachelor of Science (B. Sc.) Part – I: Botany**

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**Semester II**

**Theory Paper III (BBT 201) Plant Diversity II (Pteridophytes, Gymnosperms, Angiosperms and Palaeobotany)**

**Learning Objectives:**

1. To make the students aware about the higher plants.
2. To impart the knowledge of fossil plants.

**Unit I: Pteridophytes (09)**

General characters, Economic importance, Morphology, Anatomy and life cycle pattern (excluding developmental stages) of Lycopsidea – *Selaginella* and Pteropsida – *Pteris*; Heterospory and seed habit.

**Unit II: Gymnosperms (09)**

General characters, Economic importance, Morphology, Anatomy and life cycle pattern (excluding developmental stages) of Gnetopsida – *Gnetum*.

**Unit III: Angiosperms (09)**

General characters, Life cycle pattern in angiosperms, Systems of classifications – Natural, Artificial and Phylogenetic, Study of Angiosperm families – morphological, floral and distinguishing characters of following families, with plants of economic importance (at least five).

- i. Fabaceae (Papilionaceae) ii. Solanaceae iii. Nyctaginaceae iv. Liliaceae.

**Unit IV: Paleobotany (09)**

Introduction, Geological time scale, Process of Fossil formation, Types of fossils – Compression, Impression, Petrification, Pith Cast and Coal balls.

**References:**

Unit 1:

1. Bierhorst DW (1971) Morphology of Vascular plants

2. Bower FO (1963) The Ferns
3. Jermy AG (1973) The Phylogeny and Classification of ferns.
4. Parihar NS (1959) An Introduction to Pteridophyta
5. Rashid A (1978) An introduction to Peridophytes
6. Spome KR (1966) Morphology of Pteridophytes
7. Trivedi AN (2002) Advances in Pteridology
8. Vashishta BR (1996) Botany for degree students – Pteridophytes

Unit 2:

1. Bhatnagar SP and Moitra A (1996) The Gymnosperms.
2. Bierhorst DW (1971) Morphology of vascular plants
3. Chamberlein CJ (1966) Gymnosperms, Structure and Evolution
4. Coulter and Chamberlein JM, Morphology of Gymnosperms
5. Foster AS and Gifford EM (1959) Comparative morphology of vascular plants
6. Ramanujan CGK (1979) Indian Gymnosperms in Time and Space
7. Sporne KR (1967) Morphology of Gymnosperms
8. Vashistha PC (1976) The Gymnosperms

Unit 3:

1. Eames AJ and Giffard EM (1950) Comparative morphology of vascular plants
2. Cronquist A (1981) An Integrated System of Classification of Flowering Plants Columbia University Press, New York.
3. Cronquist A (1988) The Evolution and Classification of Flowering Plants (2<sup>nd</sup> ed.) Allen Press, USA
4. Davis PH, Heywood VH (1991) Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.
5. Hutchinson J (1959) Families of Flowering plants.
6. Lawrence GHM (1951) Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi.
7. Manilal KS, Muktesh Kumar MS (1998) A Handbook of Taxonomic Training. DST, New Delhi.
8. Naik VN (1984) Taxonomy of Angiosperms. Tata McGraw-Hill Publication Com. Ltd. New Delhi

Unit 4:

1. Andrews HN (1961) Studies in Palaeobotany
2. Arnold CA (1972) An Introduction to Palaeobotany
3. Darroh WC (1960) Principles of Palaeobotany
4. Shukla AC and Mishra SD (1975) Essentials of Palaeobotany
5. Stewart WN (1983) Palaeobotany and the evolution of plants, Cambridge U.S.
6. Surange KR (1968) Indian Fossil Pteridophytes

**Learning Outcomes:**

1. The students should be able to explain features and uses of vascular plants.
2. The students should be able to define concepts regarding vascular plants and fossils.
3. The students should be able to write answers and brief notes about plant diversity of vascular plants.



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**Bachelor of Science (B. Sc.) Part – I: Botany**

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**Semester II**

**Theory Paper IV (BBT 202) Fundamental Botany (Morphology, Anatomy and Embryology)**

**Learning Objectives:**

1. To impart the knowledge of basic structures of higher plants.
2. To impart the knowledge of developmental events in plants.

**Unit I: Morphology of vegetative plant parts (09)**

Morphology of roots – Tap root and adventitious root system, functions of root, root modifications; Morphology of shoot – Shoot system, functions of stem, stem modifications; Morphology of leaf – Parts of typical leaf: petiole, lamina, leaf margins and apices; Types of leaves: Simple and Compound, Leaf venation and phyllotaxy, functions of leaf, leaf modifications.

**Unit II: Morphology of reproductive plant parts (12)**

Inflorescence- Definition and significance, Types of inflorescence – Racemose: Raceme, Spike, Spadix, Umbel and Capitulum, Cymose: Solitary cyme, Uniparous cyme: Helicoid and Scorpioid, Biparous cyme and Multiparous cyme. Special types: Verticillaster, Cyathium and Hypanthodium, Flower – typical structure of flower, types of flowers; Fruit – Morphology of fruits, Types of fruits- Simple fruit: I. Fleshy- Berry and Drupe; II. Dry: Achene, Cypsella and Legume, Aggregate fruit: Etaerio of follicles and Etaerio of Berries, Multiple fruit: Syconus and Sorosis.

**Unit III: Development of Flower (09)**

Concept of flower as modified shoot, Structure of anther, microsporogenesis and structure of male gametophyte, Structure of pistil, megasporogenesis and structure of female gametophyte, types of ovules.

#### **Unit IV Pollination and Fertilization (06)**

Types of pollination in brief and its significance, Double fertilization and triple fusion, endosperm formation, Structure of embryo- monocotyledons and dicotyledons.

#### **References:**

##### Unit 1:

1. Gangulee HS, Das and Datta (1992) College Botany Vol. I, New Central Book Agency (P) Ltd.
2. Gangulee HS and Kar AK (1992) College Botany Vol. II, New Central Book Agency (P) Ltd.
3. Pande BP (2010) College Botany Vol. II, S Chand Ltd.

##### Unit 2:

1. Pande BP (2001) A textbook of Botany: Angiosperms – Taxonomy, Anatomy, Embryology and Economic Botany
2. Gurucharan Singh (2004) Plant Systematics: An Integrated Approach, Science Publishers Inc.
3. Pandey and Chadha, 1992: Plant Anatomy and Embryology.
4. Raghavan V (1986) Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press
5. Shivanna KR and Johari BM (1985) The Angiosperm Pollen, structure and function.

##### Unit 3 and 4:

1. Bhojwani and Bhatnagar 1992 The Embryology of Angiosperms. Vikas Publication House. New Delhi.
2. Pande BP (2001) A textbook of Botany: Angiosperms – Taxonomy, Anatomy, Embryology and Economic Botany
3. Pandey and Chadha, 1992: Plant Anatomy and Embryology.
4. Raghavan V (1986) Embryogenesis in Angiosperms: A Developmental and Experimental Study, Cambridge University Press
5. Shivanna KR and Johari BM (1985) The Angiosperm Pollen, Structure and Function.

**Learning Outcomes:**

1. The students should be able to explain the concepts of fundamentals of plant sciences.
2. The students should be able to define the characteristic feature of plant development and angiosperm taxonomy.
3. The students should be able to write answers and brief notes about basics of morphology and development in angiosperms.

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**Bachelor of Science (B. Sc.) Part – I: Botany**

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**Semester II**

**Practical Paper II (BBP 203) Practicals based on Theory Paper I and II**

**Learning Objectives:**

1. To give practical knowledge to students about identification of plants around them.
2. To give the practical knowledge about morphological and anatomical variations in plants.

**Practicals:**

1. Study of Pteridophytes through representative members *Selaginella* and *Pteris*.
2. Study of Gymnosperms through representative members *Cycas* and *Gnetum*.
3. Study of types of fossils (Compression, Impression, Petrification, Cast and Coal Balls).
- 4-5. Study of Inflorescence: Racemose: Raceme, Spike, Spadix, Umbel and Capitulum.  
Cymose: Solitary cyme, Uniparous cyme: Helicoid and Scorpioid, Biparous cyme and Multiparous cyme. Special types: Verticillaster, Cyathium and Hypanthodium.
6. Study of flower with respect to essential and accessory floral whorls.
- 7-8.. Study of fruits with suitable examples  
Simple fruit: I. Fleshy- Berry and Drupe; II. Dry: Achene, Cypsella and Legume  
Aggregate fruit: Etaerio of follicles and Etaerio of Berries  
Multiple fruit: Syconus and Sorosis
9. Study of Vegetative and Floral characters of Family Fabaceae (Papilionaceae) and Solanaceae.
10. Study of Vegetative and Floral characters of Family Nyctaginaceae and Liliaceae..
11. Field visit and tour report.

**Learning Outcome:**

- 1-2 The student shall know habit, morphology, structure and phases of the plant form studied.
- 3 The student shall observe and learn to identify the different fossil forms.

- 4-5 The student shall observe and learn to identify the different forms of inflorescence.
- 6 The student shall observe, dissect and study the structures related to a flower.
- 7-8 The student shall observe and learn to identify the different types of fruits.
- 9-10 The student shall observe the specific features of a plant and learn to identify the family it belongs to based on the features studied.
11. The student should undertake field visit, short trips and be able to submit an account of it in the form of report.

**Books Recommended:**

1. Bendre A (2010) Practical Botany, Rastogi Publications
2. Pande BP, Modern Practical Botany, Vol. I, S Chand Publishers
3. Pande BP, Modern Practical Botany, Vol. II, S Chand Publishers
4. Wallis CJ (1966) Practical Botany for Advanced Level and Intermediate Students (5<sup>th</sup> Ed.), William Heinemann Medical Books Ltd.