

UNIVERSITY OF PUNE

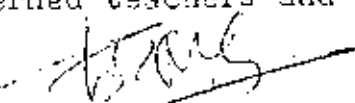
Circular No. 228 of 1996

In pursuance of the decision taken by the University authorities, it is hereby notified for the information of all concerned that the revised syllabus for F.Y.B.Sc. in Botany is as given in appendix 'A'.

This revised syllabus will be implemented from the Academic year 1996-97.

The Principals of all affiliated Colleges in Science where Botany is taught, are requested to bring the contents of this circular to the notice of all concerned teachers and students.

Ganeshkhind,  
Pune-411 007  
Ref.No.CB/S/Botany/582  
Date : 13/6/96

  
for Registrar

Copy f.w.cs. to for information :

- 1) The Dean, faculty of Science.
- 2) The Principals of all affiliated college in Science
- 3) The members of the Board of Studies in Botany
- 4) The Dy.Registrar (Examination 1,2,3,4)
- 5) The Asstt.Registrar (Exam.Co-ordination Unit)
- 6) The Data Processing Unit, Pune-7.
- 7) The Dy.Registrar, Admission.
- 8) The Asstt.Registrar (Admission)
- 9) The Section Officer, (External)
- 10) The Section Officer, (Affiliation)
- 11) The Section Officer (Recognition)
- 12) The Asstt.Registrar (Strong Room)
- 13) The Controller of Examinations.
- 14) The Director, SCUD
- 15) Asstt.Registrar S & T Unit)
- 16) The Public Relation Officer
- 17) The Law Officer,
- 18) The University Syb-Centres, Ahmednagar, Dhule, Nasik
- 19) The Section Officer (Eligibility) section.

Ref.A.C. B63 PA 63/96 dt. 19.2.1996 & 7.8.3.1996  
B-63/96

csa/ 7364/96

University of Pune  
BOTANY  
F.Y. BSc.  
Revised syllabus

प्रस्ताव क्र.ब ६३ चे परिशिष्ट

वि.प.दि.१९.२.१९९६

Theory paper I - Morphology, Anatomy and Plant Ecology

Theory paper II - Plant diversity and plants and human welfare

Practical course - based on paper I & II

First term -

Paper I - Morphology and Anatomy  
Paper II - Plant Diversity

Second term

Paper I - Plant Ecology  
Paper II - Plants and human welfare.

Paper 1 : Morphology Anatomy and Plant Ecology

First Term : Morphology and Anatomy

- Morphology -

1. Scope and importance of morphological Study : external, internal, descriptive, interpretative. Importance in identification, nomenclature, classification, Phylogeny, plant breeding.  
Lectures - 2.
2. General Organization of a plant body, axis - Underground, aerial, appendages, differences between dicot and monocot body plan.  
Lecture - 1.
3. Inflorescence - Definition, significance, parts, classification - racemose, cymose, types- raceme, panicle, spike, spadix, corymb, umbel, catkin, capitulum, head, solitary cyme, uniparous, biparous, multiparous, hypanthodium, coenanthium, cyathium, verticillaster.  
Lectures - 4.
4. Flower - definition, parts of a typical Flower, Symmetry of a flower - actinomorphic, Zygomorphic. Thalamus-forms, anthophore, androphore, gynophore, carpophore, hypogyny, perigyny, epigyny. Calyx - variations, Modifications - petaloid, pappus, spurred. Corolla - types - cruciform, papilionaceous, tubular, campanulate, infundibuliform, ligulate, bilabiate. aestivation - definition, types, significance. androecium - parts of a Stamen, variations - cohesion, adelphy, syngeny, synandry. Adhesion - episepalous, epipetalous, epiphyllous, gynandrous, Gynaecium - parts of a carpel, types - simple and compound, apocarpous and syncarpous ovary, ventral and dorsal suture, placenta, Placentation - types and significance. Flower as a modified shoot - concept and evidences.  
Lectures - 7.
5. Fruit - definition, parthenocarpy, parts of a fruit, true and false fruits, classification. Simple fruits - achene, caryopsis, samara, cypsela, nut, legume, follicle, capsule, drupe, berry - hesperidium, pome, pepo. Aggregate. fruits - different types, Multiple fruits - Sorosis, Syconia.  
Lectures - 4.

[ Note - While teaching morphology of organs mention should be made wherever possible about their primitive/advance nature ]

- Anatomy -

1. Introduction, meaning, importance, applications in taxonomy Physiology, Phylogenetic studies, ecological interpretations, pharmacognosy, wood identification. Techniques - Peeling, maceration  
Sectioning - hand sections, microtome sections. (details of microtechnique not expected. )

Lectures - 3.

2. Meristems : Theories of organization of apical meristem - apical cell Theory, histogen Theory, tunica corpus theory - concept merits and demerits of each.

Lectures - 2.

3. General Organization of Primary plant body - epidermis, ground tissue, vascular bundles.

Lecture - 1.

4. Primary structure of dicot root and stem, structure of monocot root and stem and structure of monocot and dicot leaf.

Lectures - 6.

5. Secondary growth - Introduction, definition, Significance. Normal secondary growth in dicot root and stem - stelar and extra stelar, annual rings, heart wood, sap wood, Lenticels.

Lectures - 6.

Total lectures - 36

Second Term : Plant Ecology

1. Introduction to Plant Ecology

- i) Definition, Scope and its relevance to other Sciences.
- ii) Divisions and subdivisions of ecology.
- iii) Applied aspects of ecological studies.

Lectures - 2

## II. The Environment

1) Principles pertaining to environment and plant.

(i) Components :-

- a) Atmosphere : Gases, Wind, Measurement of wind velocity and direction.
- b) Soil : Soil profile, component, Soil texture, Chemical composition, Organic matter, Soil moisture, Soil classification, Soil types met in the state of Maharashtra.
- c) Topography : General features
- d) Water : Forms of water, classification, dissolved gases and nutrients in water.
- e) Energy : Light - sources, quality and quantity, measurement by photometer, Light climate in water column.  
Heat - Sources, latitudinal distribution of solar energy on the earth, temperature and its record by thermohygrograph.
- f) Biota : Brief account of biota of soil, water and land.

Lectures - 6.

iii) Agroclimatic zones of Maharashtra.

Lectures - 2.

## III. Plant Adaptations (External and Internal)

- 1) Introduction
- ii) Adaptations influenced by altitude
- iii) Adaptations as influenced by hydrature : Range of water requirement and tolerance and Schimper's classes as hydrophytes, Mesophytes, Xerophytes; Subcategories of hydrophytes, mesophytes & xerophytes, morphological, anatomical and physiological adaptations of each category.
- iv) Adaptations as influenced by soil : Soil characters and Warming's classification.
- v) Adaptation induced by fire and grazing animals (herbivores).

Lectures - 8.

## IV. Study of Ecosystem

- 1) Concepts
- ii) Processes within ecosystem

- a) Metabolic and Adaptive processes of the organism.
- b) Role of producer, Consumer, and decomposer.
- c) Production : Kinds, Importance of Primary productivity and its measurement.
- d) Energy flow in ecosystem/natural communities.
- f) Altonian concept of food chain, food web, ecological pyramid.
- g) Concept of homeostasis.

Lectures - 3.

## V. Major ecosystem

### i) Forest Ecosystem

- a) Introduction
- b) Indian bioclimatic zones and their distinguishing floristic elements.
- c) Case study : Western Ghat forest ecosystem with respect to Mahabaleshwar, structural components and productivity.

Lectures - 4.

### ii) Grassland Ecosystem

Introduction to kinds of grasslands and their characteristic features.

Lectures - 2.

### iii) Desert Ecosystem

Introduction to different types of desert ecosystem and its vegetation in India.

Lectures - 2.

### iv) Freshwater Ecosystem

- a) Lotic and lentic water series, freshwater marshes, characteristic features of each type & Zonation patterns.
- b) Case study : Pond ecosystem from India with reference to physicochemical characters, primary producers, consumers, primary production and fish productivity.

Lectures - 3.

v) Marine Ecosystem

- a) Features of marine environment, kinds of marine environment (open sea, intertidal) and their characteristic vegetation (Phytoplankton, seaweeds and mangroves), estuaries as specialized ecotone and productivity.
- b) Case study :  
Sundarban tidal Forest : location, topography, physiognomy, soil, water & climate, floristic patterns, productivity.

Lectures - 4.

Total Lectures - 36.

Paper II - Plant diversity and Plants & human welfare  
First Term : Plant diversity

Plant diversity

- 1)a. - Why to study Botany ? Survey of avenues available for botanist.
- b. Different aspects of plant diversity.

Lectures - 2.

2) Review of systems of classification

- i) Two kingdom system :- Plantae and animalia.
- ii) Three kingdom system :- Microbes, Plantae and animalia
- iii) Five kingdom system :- Monera, Protista, Plantae, fungi and animalia
- iv) Concepts of domains.  
Broad outline, salient features, merits and demerits of each.

Lectures - 3.

3) Broad survey of major plant groups

Cryptogams - Thallophyta - Algae, fungi, bacteria, and Lichens  
Phanerogams - Gymnosperms, Angiosperms - Monocotyledons and Dicotyledons.

Distinguishing characters of these groups, with mention of few common examples from each.

Lectures - 4.

4) Escherichia Coli

Occurrence, ultra-structure, nutrition, reproduction - asexual and sexual, Importance. Lectures - 2.

5) Life history of Spirogyra :- Habit and habitat, structure of thallus, structure of a typical cell, nutrition, reproduction - Vegetative and sexual, alternation of generations. Systematic position with reasons.

Lectures - 3.

6) Life history of Sargassum : Habit, habitat, external and internal structure, reproduction : vegetative and sexual, (Development of conceptacles and gametangia not expected), alternation of generations, systematic position with reasons.

Lectures - 4.

7) Life history of Cystopus : Occurrence, structure of mycelium, nutrition, reproduction - vegetative, asexual and sexual, Alternation of generations, Systematic Position with reasons.

Lectures - 3.

8) Life history of Riccia : Habit, habitat, external and internal structure of thallus, reproduction - Vegetative, asexual and sexual - structure of sex-organs, fertilization, structure of mature sporophyte (Development of sex organs and sporophyte not expected) structure of spore, alternation of generations, systematic position with reasons.

Lectures - 5.

9) Life history of Selaginella : Habit and habitat, external morphology of the sporophyte, reproduction - vegetative, asexual and sexual. Asexual reproduction :- structure of strobilus, sporangium, microspore and megaspore. Sexual reproduction - structure of male and female gamatophytes, structure of sex-organs, fertilization, structure of embryo, Alternation of generations, systematic Position with reasons. (Anatomy of vegetative parts not expected).

Lectures - 5.

10) Life history of Pinus : Habit and habitat, morphology of root, stem and leaves (Anatomy not expected).

Asexual reproduction :- structure of male cone, microsporophylls, microsporangia and microspores, structure of female cone, ovuliferous scale, bract scale, structure of ovule, Pollination. (Theories regarding morphological nature of ovuliferous scales not expected).



Sexual reproduction :- structure of male and female gametophytes, structure of archegonium, fertilization, structure of mature embryo, Polyembryony, structure of seed. Alternation of generations, Systematic Position with reasons following C.T. chamberlain. (Development of gametophytes, sex organs and embryo not expected.)

Lectures - 5.

Total Lectures - 36.

(Note - 1) Systematic position of Spirogyra, Sargassum, Cystopus, Riccia and Selaginella be given according to G.M. Smith.  
2) Influence of environmental factors on patterns of life cycles be mentioned wherever possible)

Second Term : Plant and Human welfare

Plants and Human welfare

1- Introduction.

- 1.1 Domestication of plants and origin of agriculture  
(i) Time, (ii) Place, (iii) Mode of origin.
- 1.2 Cultural uses of Plants.  
Uses of plants in ancient human cultures in Asia, Africa, Europe and America.
- 1.3 Plant diversity and centres of origin of crops.  
Discussion of concept of centres of origin postulated by N.I. Vavilov.
- 1.4 A brief account of plants and their products useful to man.

Lectures - 3.

2. Plants That Feed us.

- 2.1 Cereals -  
Meaning of the term, examples of major cereals, minor cereals and millets, mention of regions of their cultivation, Merits of cereals as food plants.
- 2.2 Salient features of wheat, rice, maize, jowar and nachani.
- 2.3 Products - bakery products, flasks, popcorns, Sphagheti, Soji (rawa), idli.
- 2.4 Non-cereals -  
Salient features of Potato, tapioca and arrowroot.
- 2.5 Products - Wafers, chips, sago, biscuits.

Lectures - 2.

2.6 Pulses -

Meaning of the term, examples of important pulses - bengal gram, pigeon's pea, pea, bean moong, udit, soybean. Importance of pulses in diet. Salient features of bengal germ, pigeon's pea and moong. Products - kabuli, basan, wafers (papad).

Lecture - 1.

2.7 Edible Oils -

Importance of edible oils in diet, examples of plants yielding edible oils, - groundnut, carthamus, mustard, sesame, cocconut, sunflower, soybean. Salient features of ground nut, carthamus and mustard. Products - Vanaspati ghee, refined Oils, oil cake.

Lecture - 1.

2.8 Vegetables and fruits -

Importance of vegetable and fruits in diet. Examples of vegetables obtained from roots (carrot, radish, beat), stem, (Knol Knol, amorphophalus) leaf (Palak, methi) flower (cauliflower, sesbania), fruits (brinjal, cucurbits, tomato.) Examples of dry and fleshy fruits - mango, grapes, banana, cashewnut. Products - Pickles, jams, jellies, Ketchups, squash and syrup.

Lecture - 1.

3- Plants That cure

3.1 Introduction -

A brief historical account, importance of plants in medicine.

3.2 Active Principles -

General physical and chemical properties of alkaloids, glycosides, essential oils and tannins, (Further classification of the above active principles is not expected.)

3.3 Study of the following medicinal plants with reference to brief morphological description, part used, active principle/s, diseases or disorders against which it is used, any other uses. Cinchona, Rauwolfia, Catharanthus, Adhatoda, Beheda, Digitalis, Dioscorea.

Lectures - 3.

#### 4- Spices and Condiments

- 4.1 Introduction -  
Difference between spices and condiments, influence of spice trade on human history.
- 4.2 Importance of spices and condiments in diet, examples of spices and condiments - from stem (curcuma, ginger) Leaf (coriander, kadhipatta), flower (clove, saffron), fruit (carum, cardamom), seed (nutmeg), Bark (cinnamon).
- 4.3 Morphology of part used as spice or condiment, chemical constituents and uses of the following - black pepper, cinnamon, cardamom and nutmeg.

Lectures - 2.

#### 5.- The cup that cheers (Non alcoholic beverages)

- 5.1 Introduction -  
What are beverages? alcoholic and non alcoholic beverages, major non-alcoholic beverages- tea, coffee and cocoa.
- 5.2 Tea :-  
Brief history, centre of origin, salient features of tea plant, cultivars of tea, chemical constituents.
- 5.3 Coffee :-  
brief history, centre of origin, salient features of coffee plant - varieties such as blue mountain, french mission, kent mundo novo; harvesting and processing, dry and wet methods, roasting, chicory, instant coffee and chemical composition.
- 5.4 Cocoa -  
Brief history, centre of origin, salient features of cocoa plant, varieties of cocoa, harvesting and processing chemical constituents, cocoa Products.

Lectures - 3.

#### 6- Plant perfumes and cosmetics.

- 6.1 Introduction -  
History, natural and artificial perfumes, importance of perfumes in human life.
- 6.2 General characters of essential oils.
- 6.3 Various parts of plants from which essential oils are obtained - root (vetivera), stem (sandal wood) leaf (eucalyptus) flowers (rose, jasmine), fruit (orange) seed (nutmeg).

- 6.4 Extraction of essential oils by water distillation, enfleurage, alcohol/petroleum.
- 6.5 Uses - creams, soaps, detergents, paper, plastics, antiperspirants.
- 6.6 Important characters of the following plants : Champaka, clove, citrus, sandalwood, cinnamonella.
- 6.7 Cosmetic - history and importance in life.
- 6.8 Cosmetic products - Shampoo, cream, lotions, perfumes.
- 6.9 Study of following plants with respect to important morphological characters, part/s used and ingredients - Turmeric, sandalwood, lemon, rosemary, rose, mint, chamomile, licorice, aloe, henna, salvia.

Lectures - 4.

### 7- Plant in Industries

- 7.1 Introduction - Industries in which plants are used as raw materials reference should be made to the following industries :- Timber, paper, textile, rubber and sugar.
- 7.2 Timber - What is timber ? porous and non porous wood, sapwood and heartwood, grain and figure, spring and autumnwood, properties of wood, seasoning of wood, uses of wood - Veneers, Plywood, laminated timber, Cork. Important characters of teak, shisham and deodar.
- 7.3 Textile and cordage - Plant sources of fibres used in textile industry, characters and chemical composition of cotton fibre, Uses of cotton, mercerized cotton, absorbent cotton. Important characters of cotton plant.
- Coir - Process by which coir is obtained characters and uses.  
Ratanacane fibres - process by which fibre is obtained, uses
- 7.4 Sugar - Harvesting, extraction of juice, purification, concentration and crystallization, refining. Byproducts - Molasses, bagasse. Important characters of sugarcane.

Lectures - 5

## 8- Lower plants in Service of man

### 8.1 Introduction -

General account of uses of lower plants to man.

### 8.2 Lower plants as sources of food.

Use of algae as food and food supplements, nutritional value, important ingredients. Reference be made to the following - Porphyra, Laminaria, Ulva, Alaria, Spirulina, Chlorella, Chondrus.

Use of algae as fodder with reference to Ascophyllum, Laminaria, Sargassum, Fucus.

Use of fungi as food - food value of fungi with reference to Agaricus, Plaurctus, Morchella, (Morels) and Yeast.

Use of Aspergillus, Penicillium and yeast in making cheese, use of yeasts in making bread.

### 8.3 Lower plants in industries -

Alginates - Commercial sources of alginates, Properties and uses.

Agar-Agar - Commercial sources of agar agar, properties and uses.

Carrageenin - commercial sources of carrageenin, properties and uses.

Brief explanation of use of fungi in the following industries - fermentation, bakeries, plastic and paper.

### 8.4 Use of lower plants in agriculture -

Use of algae as fertilizers. Use of fungi in biological control and soil fertility. Use of bryophytes in soil reclamation.

### 8.5 Lower plants in medicine -

algae, fungi as sources of antibiotics - Sources, properties and uses of chlorellin and penicillin. Sources, properties and uses of nicotine. Medicinal uses of bryophytes and pteridophytes.

Lectures - 3.

## 9- Conservation of Plants -Gene Banks

### 9.1 Introduction -

Concept of gene bank, natural gene banks (centres of diversity), Biosphere reserves, sacred groves.

9.2 Categories of plants which need to be conserved : cultivars, obsolete cultivars, primitive cultivars, wild species and weedy species related to crops, wild species with a potential for development into crop and special genetic varieties.

- 9.3 Methods of conservation -  
In situ, invitro (tissue culture, cryogenic preservation.)
- 9.4 Steps in conservation -  
Collection, cleaning, drying, storage, labelling  
accessing, viability test.
- 9.5 Agencies - Government, Non Governmental.
- 9.6 Examples of established gene banks - International Rice Research Institute, Philippines; Royal Botanic Gardens, Kew.

Lectures - 2.

Practicals based on Theory paper-I  
(Morphology Anatomy and Plant ecology)

A) Morphology :

1. Study of inflorescence.  
Types of racemose inflorescence and types of cymose inflorescence as per theory syllabus. Study of special types of inflorescence hypanthodium, coenanthium, cyathium, verticillaster.
2. Study of morphology of flower.  
Typical flower, forms of thalamus, Hypogyny, epigyny, perigyny.  
Anthrophore, and rophore, gynophore, carpophore  
Calyx - modification.  
Corolla - forms as per theory syllabus  
 aestivation - Types.
3. Study of morphology of flower.  
Androecium - Cohesion  
Adhesion  
Modifications  
Gynoecium - Parts of carpel, types  
Placentation - types  
Study of morphology of flowers with help of any one example
4. Study of morphology of fruits  
Different types  
i) Simple fruits  
ii) Aggregate fruits  
iii) False fruits  
iv) Multiple fruits

As per theory syllabus

B) Anatomy - (students are expected to prepare single stained temporary mounts of transverse sections.)

5. Study of primary structure of dicotyledon root and stem.  
e.g. Sunflower.
6. a) Study of primary structure of monocotyledon stem and root.  
e.g. Maize.  
b) Study of dicot and monocot leaf.  
e.g. sunflower and maize leaf.
7. Study of secondary growth in dicot root.
8. Study of secondary growth in stem.  
Extra stelar - ex. Achyranthes stem.  
Intra stelar - ex. sunflower stem.

C. Plant ecology :

9. Study of ecological adaptations as expressed in external and internal morphology of
  - i) Hydrophytes - ex. Hydrilla/Vallisneria  
Eichhornia/Pistia
  - ii) Xerophytes - Casuarina/Nerium  
Opuntia/Aloe
11. Study of soil with reference to Colour, texture, water holding capacity and pH.
12. Estimation of dissolved oxygen in water by Winkler's method and estimation of free CO<sub>2</sub>

Practicals on theory Paper II

Plant diversity and plants and human welfare. (12 practicals)

13. Study of Spirogyra Classification and characters of Spirogyra, Nostoc, Hydrodictyon, Diatoms, Batrachospermum
14. Study of Sargassum (Students should take T.S. of Thallus & receptacle)
15. Study of classification and characters of Mucor/Rhizopus, Erysiphe/Xylaria, Agaricus and Alternaria.  
Lichens (three types)
16. Study of Riccia - External & internal structure of Thallus. Demonstration of reproductive structure with help of permanent slides. Classification and characters of ANTHOCEPCS, Funaria.

- 17 Study of Selaginella. (Anatomy not expected. Demonstration of permanent slide of reproductive structure) Classification & characters of Equisetum, Adiantum, Pteris.
- 18 Study of Pinus (Anatomy not expected. Mounting of pollen grains & demonstration of permanent slide of reproductive structure). Classification and characters of Thuja, Araucaria, Gnetum and two specimens each from Dicot & Monocots.

Survey of Plants in human welfare (Demonstration practical)

19. Study of following plants with reference to their botanical names, vernacular names, parts used and uses :-

a) Plants that feed us -

Cereals - Rice/Wheat/Maize

(any two)

Pulses - Gram/Soybean/Green gram (moong)

(any two)

Vegetable oils - Peanut/Safflower/Sunflower

(any two)

b) Plant that cure

1) Catharanthus

2) Dioscoria

3) Vasaka

4) Hirda

5) Asparagus (Shatavari)

(any four)

c) Spices and condiments -

1) Black pepper/Cinnamom

2) Cardomon/Nutmeg.

d) Beverages -

1) coffee/Tea

e) Plants as source of energy

1) Casuarina

2) Leucaena



20) (Demonstration practicals)

a) Plants in Industries :-

- 1) Paper - Bamboo.
- 2) Timber - T.
- 3) Textile - Cotton
- 4) Cordage - Coconut or Sunn Hemp (Crotalaria)

b) Plants in Perfumes

- 1) Michelia - (Son-Chapha)
- 2) Vetiveria - (Wala)

c) Plants in cosmetics

- 1) Turmeric
- 2) Aloe

d) Lower plants in service of man.

- 1) Gracillaria
- 2) Nostoc
- 3) Mushroom
- 4) Penicillium
- 5) Claviceps (sclerotia)
- 6) Sphagnum/moss
- 7) Lycopodium - Plant and spores.

21. Phytochemical study of plants.

Morphology, extraction and qualitative tests for active ingredients present in following plants :

- a) Tannins - Terricaria belerica./Bark of Acacia.
- b) Alkaloid - Adnalousa vasica  
or  
Nicotiana tabacum
- c) Essential Oils - Eugenia caryophyllata  
or  
Zingiber officinal

22. a) Extraction of essential Oils (Demonstration practical)

- i) Distillation
- ii) Enflaurage

- b) Preparation of rose water.
- c) Preparation of cosmetic product.

Objectives of Syllabus

The Syllabus aims at imparting sound training in fundamental and applied aspects of botany. It includes various components such as concepts, principles, inter-relationships and economic aspects of plants.

The general objectives to be achieved through teaching of the Syllabus are listed below -

1. To acquaint students with external and internal organization of plant body.
2. To train students to identify different types of inflorescences, floral forms, fruits and describe them in precise morphological terms.
3. To enable students to acquire skills in section cutting and staining.
4. To emphasize importance of plant ecology through study of environmental factors, adaptations of plants and different types of ecosystems.
5. To equip students with such information which will enable them to critically evaluate systems of classification of plants.
6. To acquaint students with salient features of major groups of plants and focus their attention on plant diversity.
7. To emphasize plant diversity through study of life histories of E. coli, spirogyra, Sargassum, Cystopus, Riccia, Selaginella, and Pinus.
8. To impress upon the minds of students importance of higher plants in human welfare through study of plants that provide food, medicines, spices, beverages, raw materials for industries perfumes.

9. To emphasize importance of lower plants with respect to food, medicine, agriculture and industries.
10. To highlight the need for conservation of plants and explain methods employed in conservation.
11. To stress the influence/impact of plants on human history, culture and civilization as a whole .
12. To introduce students to the career opportunities available to botanists.

#### List of Recommended Books

1. D'Almeida J.F.P. & Myellan, D.P. Lessons in Plant Morphology.
2. Dutta S.C. Class Book of Botany 1980 Oxford Univ. Press, Calcutta.
3. Dutta S.C. Botany for degree students 1995 Oxford Univ. Press, Calcutta (Sixth Edition)
4. Naik, U.N. Taxonomy of Angiosperms
5. Esan, K Anatomy of Seed Plants
6. Eames, A.J. and Mac daeniels An Introduction of Plant Anatomy.
7. Chandurkar, P.J. Plant Anatomy.
8. Smith G.M. Cryptogamic Botany VII I & II. Tata Mac-graw Hill Publ.
9. Chapman, J.L. and M.J. Reis 1992 Ecology: Principles and applications. Cambridge (Low Price Edn.)
10. Sporne K.R. The morphology of Angiosperms 1974 B.I. Publications

11. Pande P.P. Plant Anatomy 1966 S. Chand & Co.
12. Pande B.P. College Botany Vol. I 1993 S. Chand & Co.
13. Vashistha P.C. Botany for degree students Vol. V.  
Gymnosperms
14. Vashistha, P.C. Text book of Plant Ecology.
15. Kumar, H.D. Modern Concepts in Botany, 1995
16. Ambashta, R.S. A text book of Plant Ecology.
17. Misra, K.C. Manual of Plant Ecology
18. Odum, E.P. Ecology 1991. Oxford & IBH.
19. Odum, E.P. J Fundamentals of Ecology 1995
20. Kormondy, F.J. Concepts in Ecology
21. Economic Botany of Tropics. S.P. Kochhar, Macmillan  
India Limited (1981)
22. Plants and Civilization - Second Edition. H.G. Baker  
Macmillan and Col Ltd.
23. Plants and Society. Edited by Dr. M.S. Swaminathan and  
S.L. Kochhar. Macmillan Publishers (1989)
24. Plant Extinction - A Global Crisis (Second Edition)  
H. Koopowitz and H. Kaye. Christopher Helm. London (1990)
25. Botany - Principles and Applications. Roy H. Saigo  
Barbara Woodworth

Additional references :

1. Dixit K.R. Environment, Forest Ecology and Man : In  
Western Ghats, Rawat Publications, 1991.
2. Dixit, K.R. Maharashtra in Maps Puri G.S. and Mahajan S.D.  
1960 The study of the evergreen vegetation of Mahabaleshwar  
area Bull. Botn. Survey of India. Vol 2 (1 & 2) 109-137.

3. Gadgil, M. & Vartak, V.D. 1977. Growth of Forest Types of Mahabaleshwar J. University of Poona.
4. Naskar, K., Bakshi G. Mangrove Swamps of Sunderbans. An Ecological perspective Naya Prakash Publ. 1987.