

University of Pune

Botany Syllabus

Class – S.Y. B .Sc. (To be implemented From June 2009)		
Paper	Semester - I	Semester - II
I	Fundamentals of Plant Systematics and Plant Ecology	Structural Botany(Anatomy, Embryology and Palynology)
II	Fundamentals of Plant Physiology	Fundamentals of Plant Biotechnology
III	Practicals based on Theory courses (Paper I and II)	

S. Y. B. Sc. [Botany]

(Semester I, Paper I)

Fundamentals of Plant Systematics and Plant Ecology (48 Lectures)

1. Introduction to Plant Systematics

(3L)

- 1.1 Definition, need, objectives and importance, scope of taxonomy and systematics.
- 1.2 Systematics- Principles, Concepts, Different aspects of taxonomy- Identification, Nomenclature, Classification, Kinds of systems- Artificial, Natural and Phylogenetic
- 1.3 Taxonomic Literature- Flora, Monographs, Revisions, Reference books.

2. Aspects of Taxonomy

(4L)

- 2.1 Phases of Taxonomy – pioneer, consolidation, experimental, encyclopedic.
- 2.2 Broad outline classification of Bentham & Hooker's system of classification of seed plants up to series,
- 2.3 Merits and limitations of Bentham & Hooker's system.

3. Sources of data for Systematics

(5L)

Enlisting gross features of Morphology, Anatomy, Cytology, Embryology, Phytochemistry, Micromorphology and Molecular biology, (one example from each major group of plants.)

4. Botanical Nomenclature

(4L)

- 4.1 ICBN, History, principles and some important rules of nomenclature,
- 4.2 Binomial nomenclature, coining of generic names and specific epithets.
- 4.3 Ranks & endings of taxa names.
- 4.4 Principles of priority, effective and valid publication,
- 4.5 Single and double authority citation, *Nomina conservanda*.

5. Study of Plant Families

(8L)

Study of following families with reference to systematic position, salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Meliaceae, Myrtaceae, Rubiaceae, Solanaceae, Asclepiadaceae, Euphorbiaceae and Liliaceae

Plant Ecology

1 Introduction to plant ecology.

(3 L)

- 1.1 Introduction, concept, definition, Autecology and Synecology,
- 1.2 Plant ecology in relation to environmental biology and disaster management.
- 1.3 Importance of ecology,

2 Ecosystem Ecology:

(11 L)

- 2.1 Introduction, ecological organization – species population, community ecosystem and biosphere.
- 2.2 Kinds of ecosystem, structure and function of ecosystem, abiotic components, biotic components and their role, ecosystem dynamics.

- 2.3 Ecosystem energetics – energy flow, processes within ecosystem, nutrient cycling, food chain, food web, ecological pyramids – pyramids of number, biomass, energy and homeostasis.
- 2.4 Bio-geo-chemical cycles-concept, enlisting, details of water and carbon cycle.
- 2.5 Composition and functioning of ecosystem: i) Simple – pond ecosystem, ii) Complex – forest ecosystem iii) Artificial – cropland ecosystem.

3 Ecological grouping of plants: (5 L)

Ecological grouping of plants with reference to their significance of adaptive external and internal features: Hydrophytes, Mesophytes, Xerophytes

4 Community dynamics (Ecological Succession): (5 L)

- 4.1 Introduction, causes - physiographic, climatic and biotic.
- 4.2 Succession – a) Principles b) Types – primary and secondary c) Succession on land, rock and in water
- 4.3 Stages – Nudation, Migration. Competition, Ecesis and Climax.

S. Y. B. Sc. [Botany]
(Semester I, Paper II)
Fundamentals of plant physiology
Total Lectures: 48

1. **Introduction to plant physiology** (2 L)
 - 1.1 Why to study plant physiology?
 - 1.2 Brief History of plant physiology,
 - 1.3 Plants as organic laboratories,
 - 1.4 Applications of plant physiology.
2. **Biophysical phenomenon in plant cell** (9 L)
 - 2.1 Energy transduction in cell – Bioenergetics, Laws of thermodynamics, ATP as biological energy transfer molecule.
 - 2.2 Solutions, suspensions and colloids – True solutions, percentage, molarity, molar, buffer, molal solutions, normal solutions, pH, acids, bases, salts, colloids, emulsions, hydrophilic and hydrophobic systems, gels, colloidal system – properties, Plant cell as colloidal system.
 - 2.3 Permeability – Theories of cell permeability.
 - 2.4 Diffusion – Definition, mechanism, laws of diffusion, factors affecting diffusion, diffusion pressure deficit (DPD), significance of diffusion in plants.
 - 2.5 Osmosis – Introduction, definition, types of membranes, mechanism, osmotic pressure (OP), types of osmosis – endosmosis, exosmosis, turgor pressure (TP) and wall pressure (WP), relation between OP, DPD (Suction pressure) and TP, significance of osmosis.
 - 2.6 Plasmolysis – Definition, mechanism, deplasmolysis, significance of Plasmolysis.
 - 2.7 Imbibition – Introduction, definition, mechanism, imbibition pressure, significance.
3. **Absorption of water -** (5 L)
 - 3.1 Water, “the elixir of life” - Role of water in plant life.
 - 3.2 Structure of water molecule, physico-chemical properties of water.
 - 3.3 Sources of water - soil water, gravitational, hygroscopic and capillary.
 - 3.4 Types of soil – sand, clay and loam; Water holding capacity of soil.
 - 3.5 Root hair as water absorbing part of the plant.
 - 3.6 Mechanism of water absorption - i) Active absorption.
ii) Passive absorption.
 - 3.7 Factors affecting rate of water absorption.
4. **Ascent of sap -** (4 L)

Introduction,
Mechanism of ascent of sap – i) Root pressure theory, ii) Physical force theories:
Capillarity, Imbibition, Atmospheric pressure and Cohesion-tension
Factors affecting ascent of sap.
5. **Transpiration -** (5 L)

Introduction, Definition,
Transpiration, guttation, exudation and evaporation,
Significance of transpiration,
Types of transpiration – Cuticular, Lenticular and Stomatal;
Pathway of stomatal transpiration;
Stomata – Structure, number, distribution and mechanism of opening and closing of stomata.

K^+ - Pump theory explaining stomatal opening and closing.

Factors affecting transpiration.

Atitranspirants.

6. Mineral nutrition - (6 L)

Introduction.

Essential elements, criteria of essentiality and methods of assessment of essentiality – sand culture, solution culture (hydroponics) and aeroponics.

Enlisting of major and minor elements.

Role and deficiency symptoms of N, P and K, Role of micronutrients in agriculture and horticulture.

Role of mycorrhiza in agriculture.

Liquid fertilizers, foliar nutrition and ion antagonism.

Plants as mineral indicators.

7. Mineral salt absorption - (4 L)

Introduction, soil solution, soil pH and availability of nutrients.

Regions of root involved in absorption.

Mechanism of salt absorption – i) Passive absorption : Ion exchange. Donnan's equilibrium, ii) active absorption : Lundegarth's theory.

Factors affecting salt absorption.

8. Plant growth - (3 L)

Introduction, Definition, Growth and development.

Kinetics (phases) of growth, Regions of growth and Measurement of growth.

Factors affecting growth – External and Internal.

9. Plant growth regulators - (4 L)

Introduction and definition

Discovery, site of synthesis and practical applications of – i) Auxins, ii) Gibberellins, iii) Cytokinins, iv) Ethylene, v) Abscisic acid.

10. Physiology of flowering - (6 L)

Introduction.

Regulation of sexuality.

Phytohormones and flower initiation.

Photoperiodism – Concept, definition, Short Day Plants, Long Day Plants and Day Neutral Plants, Photoperiodic induction, phytochromes and flowering.

Endogenous rhythms.

Flowering hormone.

Photoperiodism and C/N ratio.

Vernalization – Concept, mechanism and site of vernalization, cold induction technique and applications of vernalization.

S. Y. B. Sc. [Botany]
(Semester II, Paper I)
Structural Botany (Anatomy, Embryology and Palynology)

Total Lectures: 48

Anatomy:

(20L)

- 1. Introduction.** 1 L
- 2. Plant Tissues:** 4 L
 - 2.1 Ground tissues: parenchyma, chlorenchyma, collenchyma, and sclerenchyma.
 - 2.2 Vascular tissues: xylem, phloem.
 - 2.3 Secretory tissues: laticiferous, glandular.
- 3. Epidermal tissue system:** 3 L
 - 3.1 Structure and function: uniseriate epidermis, multiple epidermis,
 - 3.2 Stomata – structure and function.
 - 3.3 Epidermal outgrowths- nonglandular, glandular.
- 4. Mechanical tissue system:** 4 L
 - 4.1 Principles involved in distribution of mechanical tissues – Inflexibility, Incompressibility, Inextensibility and Shearing stress.
 - 4.2 Tissues providing mechanical support, their distribution in leaf, stem and root of dicots and monocots.
- 5. Normal secondary growth.** 4 L
 - 5.1 Introduction and need.
 - 5.2 Process in annual and perennial stem.
 - 5.3 Structure and function of periderm, bark, tyloses, growth rings and lenticels.
- 6. Anomalous secondary growth.** 4 L
 - 6.1 Definition, causes.
 - 6.2 Growth in *Bignonia* (dicot stem) and *Raphanus* (dicot root).
 - 6.3 Growth in *Dracaena* (monocot stem).

Embryology

(20L)

1. Definition and scope. 1 L
2. Microsporangium: structure of tetrasporangiate anther, tapetum types, sporogenous tissue. 3 L
3. Microsporogenesis: process, cytokinesis and its types. Types of microspore tetrad. 2 L
4. Male gametophyte: structure of pollen grain, development of male gametophyte. 2 L
5. Megasporangium: structure and types of ovules – anatropous, orthotropous, amphitropous, campylotropous, circinotropous. 2 L
6. Megasporogenesis: tenuinucellate and crassinucellate ovules, types of megaspore tetrads. 2 L
7. Female gametophyte: structure of typical 8-nucleate embryo sac, types and development of embryo sacs – monosporic, bisporic and tetrasporic. 3 L
8. Fertilization: entry of pollen tube, discharge of pollen tube content, fusion of gametes, syngamy, triple fusion, significance of double fertilization. 2 L
9. Endosperm types: nuclear, helobial, cellular. 1 L
10. Embryo - structure of dicot and monocot embryo (development not expected) 1 L

Palynology

(8L)

1. Definition, applications and importance. 3 L
2. Pollen structure - Polarity, symmetry, size and shape, apertures, exine stratification. 4 L
3. NPC system. Principles and general outline 1 L

S. Y. B. Sc. [Botany]
(Semester II, Paper II)
Fundamentals of Plant Biotechnology (48 Lectures)

1. An Introduction to plant Biotechnology. (6L)

- 1.1 What is biotechnology?
- 1.2 Biotechnology - an interdisciplinary subject.
- 1.3 Biotechnology and the developing world. (Role)
- 1.4 Substrates for biotechnology –
 - i) A biomass strategy.
 - ii) Natural raw materials.
 - iii) Availability of byproducts.
 - iv) Chemical and petrochemical feed stocks.
 - v) Raw materials for future of biotechnology.

2. Plant Genome (6L)

- 2.1 Nuclear Genome – Genetic materials, DNA replication, mechanism of DNA amplification, plant gene structure.
- 2.2 Chloroplast genome – Structure and organization.
- 2.3 Mitochondrial genome – size, structure and mitochondrial plasmids.
- 2.4 Cytoplasmic male sterility.

3. Genetic Engineering - (4L)

- 3.1 Introduction, genetic engineering - safety, social, moral and ethical aspects.
- 3.2 Release of genetically manipulated organisms to the environment.
- 3.3 Genetic modification and food uses.

4. Bioprocess Technology. (6L)

- 4.1 Introduction.
- 4.2 Principles of microbial growth.
- 4.3 Bioreactor.
- 4.4 Scale up.
- 4.5 Media design for fermentation process.
- 4.6 Solid substrate fermentation.
- 4.7 Downstream processing.

5. Enzyme Technology - (4L)

- 5.1 The nature of enzyme.
- 5.2 The applications of enzymes.
- 5.3 Technology of enzyme production.
- 5.4 Immobilized enzymes.

6. Biomass Technology for energy (4L)

- 6.1 Photosynthesis – the ultimate energy source.
- 6.2 Sources of Biomass.

- 6.3 Ethanol from biomass.
- 6.4 Methane from biomass
- 6.5 Biodiesel from plants.

7. Biomass Technology for food (Single cell protein) (4L)

- 7.1 The need for proteins.
- 7.2 Acceptability and toxicology of SCP.
- 7.3 SCP from wastes.
- 7.4 SCP from agricultural crops and residues
- 7.5 SCP from algae.
- 7.6 The economic implications of SCP.

8. Tissue culture Technology - (10L)

- 8.1 Introduction, totipotency.
- 8.2 Media composition and preparation.
- 8.3 Culture technique –
 - i) Sterilization and aseptic culture technique.
 - ii) Organogenesis and Embryogenesis.
 - iii) Single cell culture.
 - iv) Haploid production.
 - v) Somatic hybridization and cybridization, artificial / synthetic seeds.
 - vi) Applications of PTC.
 - vii) Design and economics of PTC Laboratory.

9. Environmental Biotechnology - (4L)

- 9.1 Introduction
- 9.2 Waste water treatment
- 9.3 Landfill technology.
- 9.4 Environmental sustainability.

S. Y. B. Sc. [Botany]

Paper III

Practicals based on Theory Paper I and II

Fundamentals of Plant Systematics and plant ecology (any six)

1. Study of Tools of Taxonomy – field, library and laboratory (01 P)
2. How to study plant family? (Description of plant in botanical terms) (01 P)
3. Study of plant families (any four and at least one from monocot) (02 P)
4. Botanical excursion and submission of photographs of wild plants. (01 P)
5. Study of ecological adaptations. (02 P)
 - A) Hydrophytes
 - B) Xerophytes
6. Study of vegetation by list count quadrat method. (01 P)
7. Study of Ecological instruments. (any four) (01 P)
8. Study of forest / grassland ecosystem. (01 P)

Fundamentals of Plant Biotechnology (any six)

9. Demonstration of DNA Model. (01 P)
10. Demonstration of comparison of GM Plants with Non-GM Plants. (01 P)
(BT cotton, BT Tomato)
11. Estimation of citric acid by assay method. (01 P)
12. Cultivation of *Spirulina* and Study of its commercial products. (01 P)
13. Plant tissue culture technique. (02 P)
 - A) Instrumentation, Sterilization, Media preparation.
 - B) Inoculation of Explants / Meristem / Nodal sector / Embryo.
14. Visit to biotechnology institute and submission of visit report with respect to design of PTC lab. (01 P)
15. Demonstration of synthetic seeds (01 P)
16. Visit to waste water treatment plant and submission of its report. (01 P)

Anatomy, Embryology and Palynology (any six)

17. Study of epidermal tissue system – non-glandular and glandular trichomes, multilayered epidermis, typical stomata (dicot and monocot). (01 P)
18. Study of mechanical tissues. (01 P)
19. Study of normal secondary growth in dicot stem – *Annona* and *Moringa*. (01 P)
(Double stained temporary preparation).

20. Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem. (01 P)
(Double stained temporary preparation).
21. Study of tetrasporangiate anther – T.S. of young and mature anther. (01 P)
22. A) Study of types of ovules. } (01 P)
B) Study of germination of pollen grain on stigma (in vivo). }
23. Study of dicot and monocot embryo. (01 P)
24. A) Study of pollen grains by acetolysis method. } (02 P)
B) Study of pollen grains by NPC observation. }
25. Observation of exine ornamentation (any five) (01 P)

Plant physiology (any six)

26. Determine water holding capacity (WHC), pH and moisture content of soil (01 P)
27. Determine Diffusion Pressure Deficit by using potato tubers. (01 P)
28. Determine rate of transpiration under different conditions of shade,
wind and light. (01 P)
29. Demonstration Experiments. (Suction due to transpiration, Curling Experiment,
Imbibition Pressure, Effect of root promoting hormone, Arc Indicator) (01 P)
30. To study the process of plasmolysis. (01 P)
31. Preparation of phosphate buffer. (01 P)
32. Isolation of mycorrhizal fungi of any crop plant with the help of soil dilution technique
and Identification of any two fungal forms. (02 P)

N.B. Botanical excursion tours and visits are compulsory to all the students.