

PASS COURSE

B. Sc. with Botany

Details of Courses

Core Courses –Botany

1. Biodiversity (Microbes, Algae, Fungi and Archegoniate)
2. Plant Ecology and Taxonomy
3. Plant Anatomy and Embryology
4. Plant Physiology and Metabolism

Discipline Specific Electives-Botany (Any two)

1. Economic Botany and Biotechnology
2. Cell and Molecular Biology
3. Analytical Techniques in Plant Sciences
4. Bioinformatics
5. Research Methodology
6. Dissertation

Ability Enhancement Compulsory Courses

1. Environmental Science
2. English/MIL Communication

Skill Enhancement Courses (Any four)

Botany

1. Biofertilizers
2. Herbal Technology
3. Nursery and Gardening
4. Floriculture
5. Medicinal Botany
6. Plant Diversity and Human Welfare
7. Ethnobotany
8. Mushroom Culture Technology
9. Intellectual Property Right

Core Courses

Semester I

Core Course: Botany Paper I Biodiversity (Microbes, Algae, Fungi and Archegoniate)

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Microbes

(10 Lectures)

Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit 2: Algae

(12 Lectures)

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae (Lee 1989); Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae.

Unit 3: Fungi

(12 Lectures)

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification (Hawksworth et al 1995); True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance.

Unit 4: Introduction to Archegoniate

(2 Lectures)

Unifying features of archegoniate, Transition to land habit, Alternation of generations.

Unit 5: Bryophytes**(10 Lectures)**

General characteristics, adaptations to land habit, Classification (Proskauer 1954 up to class), Range of thallus organization. Systematic position, morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 6: Pteridophytes**(8 Lectures)**

General characteristics, classification (Sporne 1975), Early land plants (*Cooksonia* and *Rhynia*). Systematic position, morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

Unit 4: Gymnosperms**(6 Lectures)**

General characteristics, classification (Sporne), Systematic position, morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Practical

1. Gram staining from curd sample.
2. Study of vegetative and reproductive structures of *Nostoc*, (electron micrographs), *Oedogonium*, *Fucus** and *Polysiphonia* through temporary preparations and permanent slides. (**Fucus* - Specimen and permanent slides).
3. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
4. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
5. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.

6. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
7. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
8. **Marchantia**- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae, v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
9. **Funaria**- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores - permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
10. **Selaginella**- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll, l.s. strobilus (permanent slide).
11. **Equisetum**- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry); t.s. rhizome (permanent slide).
12. **Pteris**- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores, t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
13. **Cycas**- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores, l.s. ovule, t.s. root (permanent slide).
14. **Pinus**- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m. dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores, l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Suggested Readings

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.

4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). *Introductory Mycology*, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). *Biology*. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). *Pteridophyta*, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). *Gymnosperms*. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). *An introduction to Embryophyta*. Vol. I. Bryophyta. Central Book Depot, Allahabad.

Semester II

Core Course Botany –Paper II

Plant Ecology and Taxonomy

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Introduction (2 Lectures)

Unit 2: Ecological factors (10 Lectures)

Soil: Origin, composition, soil profile. Water: States of water in the environment, Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 3: Plant communities (6 Lectures)

Characters; Ecotone and edge effect; Succession; Processes and types.

Unit 4: Ecosystem (8 Lectures)

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen.

Unit 5: Phytogeography (4 Lectures)

Principle biogeographical zones; Endemism.

Unit 6 Introduction to plant taxonomy (2 Lectures)

Identification, Classification, Nomenclature.

Unit 7 Identification (4 Lectures)

Functions of Herbarium, important herbaria and botanical gardens of the world and India;
Documentation: Flora, Keys.

Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. (6 Lectures)

Unit 9 Taxonomic hierarchy**(2 Lectures)**

Ranks, categories and taxonomic groups.

Unit 10 Botanical nomenclature**(6 Lectures)**

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication.

Unit 11 Classification**(6 Lectures)**

Types of classification- artificial, natural and phylogenetic. Bentham and Hooker (up to series), General idea of Cronquist's classification (1981).

Unit 12 Numerical taxonomy and cladistics**(4 Lectures)**

Characters; variations; cluster analysis; phenograms, cladograms (definitions and differences).

Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, organic matter and by rapid field test.
3. (a) Study of morphological adaptations of hydrophytes (*Nymphaea* petiole) and xerophytes (*Nerium* leaf) (four each).
(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Epiphytes (Orchid root).
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the College/ suitable site by species area curve method. (Species to be listed).
5. Quantitative analysis of herbaceous vegetation in the college campus /suitable site for frequency and comparison with Raunkiaer's frequency distribution law.
6. Study of vegetative and floral characters of the following families (Description, V.S. of flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae – *Nasturtium indicum*; Asteraceae - *Eclipta* and

Tridax; Solanaceae – *Nicotiana plumbaginifolia*, *Solanum nigrum*, Lamiaceae - *Leonurus sibiricus*,
Leucas aspera and *Ocimum sanctum*; Liliaceae - *Allium*.

7. Mounting of a properly dried and pressed specimen of any ten wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). *Plant Systematics*. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

Semester III

Core Course Botany –Paper III Plant Anatomy and Embryology (Credits: Theory-4, Practicals-2) THEORY

Lectures: 60

Unit 1: Meristematic and permanent tissues (8 Lectures)

Root and shoot apical meristems; Simple and complex tissues.

Unit 2: Organs (4 Lectures)

Structure of dicot and monocot root stem and leaf.

Unit 3: Secondary Growth (8 Lectures)

Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Unit 4: Adaptive and protective systems (8 Lectures)

Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit 5: Structural organization of flower (8 Lectures)

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 6: Pollination and fertilization (8 Lectures)

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 7: Embryo and endosperm (8 Lectures)

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm relationship.

Unit 8: Apomixis and polyembryony (8 Lectures)

Definition, types and practical applications.

Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Nymphaea* petiole).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous from permanent slides.
9. Ultrastructure of mature egg apparatus cells through electron micrographs.
10. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
11. Dissection of embryo/endosperm from developing seeds.
12. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Semester IV

Core Course Botany –Paper IV Plant Physiology and Metabolism

(Credits: Theory-4, Practicals-2)

THEORY

Lectures: 60

Unit 1: Plant-water relations (8 Lectures)

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Unit 2: Mineral nutrition (8 Lectures)

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit 3: Translocation in phloem (6 Lectures)

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 4: Photosynthesis (12 Lectures)

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C₃, C₄ and CAM pathways of carbon fixation; Photorespiration.

Unit 5: Respiration (6 Lectures)

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.

Unit 6: Enzymes (4 Lectures)

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Nitrogen metabolism (4 Lectures)

Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit 8: Plant growth regulators**(6 Lectures)**

Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

Unit 9: Plant response to light and temperature**(6 Lectures)**

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
5. To study the effect of bicarbonate concentration on O₂ evolution in photosynthesis.
6. Comparison of the rate of respiration in any two parts of a plant.

Demonstration experiments (any four)

1. Effect of auxins on rooting.
2. Suction due to transpiration.
3. R.Q.
4. Respiration in roots.

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.