

## B.Sc. Botany (Hons. School)

Paper: Plant Diversity

Course Code: BOT131

L	T	P	Credits	Marks	Min. Marks
4	0	0	4	100	40

### Objective:

To acquaint the students about the morphology, biology and importance of prokaryotes, eukaryotes, algal organisms, fungal organisms, lichens, bryophytes and pteridophytes.

### Learning Outcome

The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

#### UNIT 1

**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:** General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae.  
**Fungi:** Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

#### UNIT 3

**Introduction to Archegoniate:** Unifying features of archegoniates, Transition to land habit, Alternation of generations.

**Bryophytes:** General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

#### UNIT 4

**Pteridophytes:** General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes.

**Gymnosperms:** General characteristics; Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. Ecological and economical importance.

**Paper: Plant Diversity Laboratory**  
**Course Code: BOT132**

L	T	P	Credits	Marks	Min. Marks
0	0	3	2	50	20

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus*\* and *Polysiphonia* through temporary preparations and permanent slides. (\* *Fucus* - Specimen and permanent slides)
5. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria*: Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores(temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m. spores (wet and dry)(temporary slides); t.s. rhizome (permanent slide).
15. *Pteris*- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. *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 (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

**Reference Books:**

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2<sup>nd</sup> edition.

2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10<sup>th</sup> 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. 4<sup>th</sup> 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.

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## B.Sc. Botany (Hons. School)

**Paper: Plant Ecology and Taxonomy**

**Course Code: BOT133**

L	T	P	Credits	Marks	Min. Marks
4	0	0	4	100	40

### **Objective:**

To acquaint the students about the

### **Learning Outcome**

The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

### UNIT 1

Introduction

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

**Plant communities:** Characters; Ecotone and edge effect; Succession; Processes and types

### UNIT 2

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

**Phytogeography:** Principle biogeographical zones; Endemism

### UNIT 3

Introduction to plant taxonomy: Identification, Classification, Nomenclature.

**Identification:** Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.

**Taxonomic hierarchy:** Ranks, categories and taxonomic groups

### UNIT 4

**Botanical nomenclature:** Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

**Classification:** Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series).

**Biometrics, numerical taxonomy and cladistics:** Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

**Paper: Plant Ecology and Taxonomy Laboratory**  
**Course Code: BOT134**

L	T	P	Credits	Marks	Min. Marks
0	0	3	2	50	20

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, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).  
(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobancha*), Epiphytes, Predation (Insectivorous plants)
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
7. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae - *Brassica*, *Alyssum* / *Iberis*; Asteraceae - *Sonchus/Launaea*, *Vernonia/Ageratum*, *Eclipta/Tridax*; Solanaceae - *Solanum nigrum*, *Withania*; Lamiaceae - *Salvia*, *Ocimum*; Liliaceae - *Asphodelus* / *Lilium* / *Allium*.
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book)

**Reference Books:**

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4<sup>th</sup> edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8<sup>th</sup> 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. 3<sup>rd</sup> edition.

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## B.Sc. Botany (Hons. School)

Paper: Plant Anatomy and Embryology

Course Code: BOT243

L	T	P	Credits	Marks	Min. Marks
4	0	0	4	100	40

### Objective:

To acquaint the students about the

### Learning Outcome

The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

### UNIT 1

**Meristematic and permanent tissues:** Root and shoot apical meristems; Simple and complex tissues

**Organs:** Structure of dicot and monocot root stem and leaf.

### UNIT 2

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

**Adaptive and protective systems:** Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

### UNIT 3

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

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

### UNIT 4

**Embryo and endosperm:** Endosperm types, structure and functions; Dicot and monocot embryo; Embryoendosperm relationship

**Apomixis and polyembryony:** Definition, types and Practical applications

**Paper: Plant Anatomy and Embryology Laboratory**  
**Course Code: BOT244**

L	T	P	Credits	Marks	Min. Marks
0	0	3	2	50	20

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*.
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus*.
5. Leaf: Dicot and Monocot leaf.
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

**Reference Books:**

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

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## B.Sc. Botany (Hons. School)

Paper: Plant Physiology and Metabolism

Course Code: BOT241

L	T	P	Credits	Marks	Min. Marks
4	0	0	4	100	40

### Objective:

To acquaint the students about the

### Learning Outcome

The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

### UNIT 1

**Plant-water relations:** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

**Mineral nutrition:** 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 2

**Translocation in phloem:** Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading

**Photosynthesis:** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C<sub>3</sub>, C<sub>4</sub> and CAM pathways of carbon fixation; Photorespiration.

### UNIT 3

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

**Enzymes:** Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

**Nitrogen metabolism:** Biological nitrogen fixation; Nitrate and ammonia assimilation.

### UNIT 4

**Plant growth regulators:** Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.

**Plant response to light and temperature:** Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

**Paper: Plant Physiology and Metabolism Laboratory**  
**Course Code: BOT242**

L	T	P	Credits	Marks	Min. Marks
0	0	3	2	50	20

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. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

**Demonstration experiments (any four)**

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

**Reference Books:**

1. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6<sup>th</sup> edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4<sup>th</sup> Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

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