# SyllabuS

## UndergradUate CoUrses (Under CHoICe Based CredIt SYSTeM)

## Subject: bOtANy

## Year-2020

# Bodoland University

Debargaon, KoKrajhar (b.T.a.D.)

# B.Sc. in Botany (Honours)
# CBCS Course
# Bodoland University, Kokrajhar

| Semester | CORE COURSE(14) | Ability Enhancement Compulsory Course (AECC)(2) | Skill Enhancement Course (SEC)(2) | Discipline Specific Elective (DSE)(4) | Generic Elective (GE) (4) |
|---|---|---|---|---|---|
| 1 | CC-1: Phycology and Microbiology<br>CC-2: Biomolecules and Cell Biology | English/ Hindi/MIL Communication | | | GE-1: Biodiversity (Microbes, Algae, Fungi and Archegoniate) |
| II | CC-3: Mycology and Phytopathology<br>CC-4: Archegoniate | Environmental Science | | | GE-2<br>Plant Ecology and Taxonomy |
| III | CC-5: Anatomy of Angiosperm<br>CC-6: Economic Botany<br>CC-7: Genetics | | SEC-1: Biofertilizers | | GE-3<br>Plant Anatomy and Embryology |
| IV | CC-8: Molecular Biology<br>CC-9: Plant Ecology and Phytogeography<br>CC-10: Plant Systematics | | SEC -2 Mushroom Culture Technology | | GE-4<br>Plant Physiology and Metabolism |
| V | CC-11: Reproductive Biology of Angiosperm<br>CC-12: Plant Physiology | | | DSE-1 Analytical Techniques in Plant Sciences<br>DSE-2 Bioinformatics | |
| VI | CC-13: Plant Metabolism<br>CC-14: Plant Biotechnology | | | DSE -3:Natural Resource Management<br>DSE-4: Industrial and Environmental Microbiology | |

# Structure of B.Sc. Honours Botany under CBCS

**Core Courses**

1. Phycology and Microbiology
2. Biomolecules and Cell Biology
3. Mycology and Phytopathology
4. Archegoniate
5. Anatomy of Angiosperm
6. Economic Botany
7. Genetics
8. Molecular Biology
9. Plant Ecology and Phytogeography
10. Plant Systematics
11. Reproductive Biology of Angiosperm
12. Plant Physiology
13. Plant Metabolism
14. Plant Biotechnology

**Discipline Specific Electives**

**DSE 1:** Analytical Techniques in Plant Sciences
**DSE 2:** Bioinformatics
**DSE 3:** Natural Resource Management
**DSE 4:** Industrial and Environmental Microbiology

**Generic Electives**

**GE 1:** Biodiversity (Microbes, Algae, Fungi and Archegoniate)
**GE 2:** Plant Ecology and Taxonomy
**GE 3:** Plant Anatomy and Embryology
**GE 3:** Plant Physiology and Metabolism

**Ability Enhancement Course Compulsory**

1. Environmental Science
2. English/MIL Communication

**Skill Enhancement Courses Elective**
**SEC 1:** Biofertilizers
**SEC 2:** Mushroom Culture Technology

# Curriculum Structures
# Department of Botany
# No. of papers =14+12=26, Total Credits= 140
# Total Marks = 2400

| SEM I | | | | | | |
|---|---|---|---|---|---|---|
| **Paper code** | **Course title** | **Credit** | **Credit distribution (L+T+P)** | **End semester marks** | **Internal marks** | **Total marks** |
| BOT-101H | CC1-Phycology and Microbiology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-102H | CC2- Biomolecules and Cell Biology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-103HR | GE1- Biodiversity (Microbes, Algae, Fungi and Archegoniate) | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| COMM-104HR | AEC: AECC1:English/ Hindi/MIL (Communication) | 2 | 2+0+0 | 50 | -- | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM II | | | | | | |
|---|---|---|---|---|---|---|
| **Paper code** | **Course title** | **Credit** | **Credit distribution (L+T+P)** | **End semester marks** | **Internal marks** | **Total marks** |
| BOT-201H | CC3- Mycology and Phytopathology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-202H | CC4- Archegoniate | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-203HR | GE2- Plant Ecology and Taxonomy | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| COMM-204HR | AEC: AECC1:English/ Hindi/MIL (Communication) | 2 | 2+0+0 | 50 | -- | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM III | | | | | | |
|---|---|---|---|---|---|---|
| **Paper code** | **Course title** | **Credit** | **Credit distribution (L+T+P)** | **End semester marks** | **Internal marks** | **Total marks** |
| BOT-301H | CC5- Anatomy of Angiosperm | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-302H | CC6-Economic Botany | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-303H | CC7- Genetics | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-304HR | AEC: SEC-1 Biofertilizers | 2 | 2+0+0 | 50 | - | 50 |
| BOT 305H | GE3-Plant Anatomy and Embryology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| **Total** | | **26** | **26** | **370** | **80** | **450** |

| SEM IV | | | | | | |
|---|---|---|---|---|---|---|
| **Paper code** | **Course title** | **Credit** | **Credit distribution (L+T+P)** | **End semester marks** | **Internal marks** | **Total marks** |
| BOT-401H | CC8-Molecular Biology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-402H | CC9-Plant Ecology and Phytogeography | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-403H | CC10-Plant Systematics | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-404HR | SEC2-Mushroom culture Technology | 2 | 2+0+0 | 50 | - | 50 |
| BOT-405H | GE4:Plant Physiology and Metabolism | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| **Total** | | **26** | **26** | **370** | **80** | **450** |

| SEM V | | | | | | |
|---|---|---|---|---|---|---|
| **Paper code** | **Course title** | **Credit** | **Credit distribution (L+T+P)** | **End semester marks** | **Internal marks** | **Total marks** |
| BOT-501H | CC11-Reproductive Biology of Angiosperm | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-502H | CC12-Plant Physiology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-D1HR | DSE1-Analytical Techniques in Plant Sciences | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-D2HR | DSE2-Bioinformatics | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| **Total** | | **24** | **24** | **320** | **80** | **24** |

| SEM VI | | | | | | |
|---|---|---|---|---|---|---|
| **Paper code** | **Course title** | **Credit** | **Credit distribution (L+T+P)** | **End semester marks** | **Internal marks** | **Total marks** |
| BOT-601H | CC13-Plant metabolism | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-602H | C14-Plant Biotechnology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-D3H | DSE3-Natural resource Management | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-D4H | DSE4-Industrial and Environmental Microbiology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| **Total** | | **24** | **24** | **320** | **80** | **400** |

# Semester-I

## CC-1: Phycology and Microbiology

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1:** Introduction to microbial world **(1 lecture)**

**Unit 2: Viruses** (6 **lectures)**

Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

**Unit 3: Bacteria** **(6 lectures)**

Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

**Unit 4: Algae** (**10 lectures)**

General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Significant contributions of F.E. Fritsch. Role of algae in the environment, agriculture, biotechnology and industry.

**Unit 5: Cyanophyta and Xanthophyta** (**5 lectures)**

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of *Nostoc*.

**Unit 6: Chlorophyta and Charophyta** (**6 lectures)**

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Volvox* and *Chara.*

**Unit 7: Phaeophyta and Rhodophyta** (**6 lectures)**

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus* and *Polysiphonia.*

**PRACTICAL**

**Microbiology**

1. Electron micrographs/Models of viruses – T-Phage and TMV, Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, root Nodule.
3. Gram staining.

**Phycology**

Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* Volvox, *Chara, Ectocarpus* and *Polysiphonia,* through electron micrographs, temporary preparations and permanent slides.

**Suggested Readings**

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

## CC-2: Biomolecules and Cell Biology

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1: Biomolecules** **(10 lectures)**

Types and significance of chemical bonds; pH and buffers.

**Carbohydrates:** Nomenclature and classification; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides.

**Lipids:** Definition and major classes of storage and structural lipids; Fatty acids structure and functions

**Proteins:** Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary.

**Nucleic acids:** Structure of nitrogenous bases; Types of nucleic acids.

**Unit 2: Bioenergenetics** **(1 lectures)**

Introduction

**Unit 3: Enzymes** **(6 lectures)**

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theroy).

**Unit4: The cell** **(2 Lecture)**

Introduction

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).

**Unit 5: Cell wall and plasma membrane** **(5 lectures)**

Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport.

**Unit 6: Cell organelles** **(12 lectures)**

**Nucleus:** Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

**Chloroplast, mitochondria and peroxisomes:** Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.

**Endomembrane system:** Endoplasmic Reticulum, Golgi Apparatus and Lysosomes: General account

**Unit 7: Cell division** **(4 lectures)**

Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.

**Practical**

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo.*
3. Measurement of cell size by the technique of micrometry.
4. Study of cell and its organelles with the help of electron micrographs.
5. Study the phenomenon of plasmolysis and deplasmolysis.
6. Study different stages of mitosis and meiosis.

## Suggested Readings


1. Campbell, MK (2012). Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011). Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.
3. Tymoczko JL, Berg JM and Stryer L (2012). Biochemistry: A short course, 2nd ed., W.H. Freeman.
4. Berg JM, Tymoczko JL and Stryer L (2011). Biochemistry, W.H.Freeman and Company
5. Nelson DL and Cox MM (2008). Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco


## GE-1: Biodiversity (Microbes, Algae, Fungi and Archegoniate)

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1: Microbes** **(6 lectures)**

Viruses – Discovery, general structure, replication (general account), Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

**Unit 2: Algae** **(9 lectures)**

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

**Unit 3: Fungi** **(9 lectures)**

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

**Unit 4: Introduction to Archegoniate** **(1 lectures)**

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

**Unit 5: Bryophytes** **(6 lectures)**

General characteristics, Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. Ecology and economic importance of bryophytes with special mention of

*Sphagnum*.

**Unit 6: Pteridophytes** **(5 lectures)**

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

**Unit 7: Gymnosperms** **(4 lectures)**

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

# Practical

1. EMs/Models of viruses – T-Phage and TMV.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Polysiphonia* through temporary preparations and permanent slides. (* *Fucus* - Specimen and permanent slides)
5. *Rhizopus and Penicillium*: Asexual stage from temporary mounts and sexual structuresthrough permanent slides.
6. *Puccinia*: Herbarium specimens and permanent slides
7. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
9. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus throughgemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
10. *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).
11. *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).
12. *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).

**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-III

## CC-5: Anatomy of Angiosperm

**(Credits: Theory-4, Practical-2)**
**THEORY**
**Lectures: 40**

**Unit 1: Introduction and scope of Plant Anatomy (in Brief)** **(2 Lectures)**
Applications in systematics, forensics and Pharmacognosy.

**Unit 2: Structure and Development of Plant body** **(4 Lectures)**
Internal organization of plant body: Development of plant body: Polarity, Cyto-differentiation and organogenesis during embryogenic development.

**Unit 2: Tissues** **(6 Lectures)**
Classification of tissues; Pits and plasmodesmata; Hydathodes, cavities, lithocysts and laticifers.

**Unit 3: Apical meristems** **(11 Lectures)**
Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory. Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root.

**Unit 4: Vascular Cambium and Wood** **(11 Lectures)**
Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Sapwood and heartwood; Ring and diffuse porous wood; tyloses; Dendrochronology. Development and composition of periderm.

**Unit 5: Adaptive and Protective Systems** **(6 Lectures)**
Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Anatomical adaptations of xerophytes and hydrophytes.

**Practical**

1. Study of anatomical details through permanent slides/temporary stain mounts/museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
5. Root: monocot, dicot, secondary growth.

6. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
7. Adaptive Anatomy: xerophytes, hydrophytes.

**Suggested Readings**

1. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4. Evert, R.F. (2006). Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.

## CC-6: Economic Botany

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1: Origin of Cultivated Plants** **(5 lectures)**

Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; importance of germplasm diversity.

**Unit 2: Cereals** **(4 lectures)**

Wheat and Rice (origin, morphology, processing & uses)

**Unit 3: Legumes** **(4 lectures)**

Origin, morphology and uses of Chick pea, Pigeon pea. Importance to man and ecosystem.

**Unit 4: Sources of sugars and starches** **(3 lectures)**

Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

**Unit 5: Spices** **(4 lectures)**

Listing of important spices, their family and part used. Economic importance with special reference to fennel, clove and black pepper

**Unit 6: Beverages** **(3 lectures)**

Tea, Coffee (morphology, processing & uses)

**Unit 7: Sources of oils and fats** **(6 lectures)**

General description, classification, extraction, their uses and health implications, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

**Unit 8: Natural Rubber** **(2 lectures)**

Para-rubber: tapping, processing and uses.

**Unit 9: Drug-yielding plants** **(4 lectures)**

Therapeutic and habit-forming drugs with special reference to C*inchona, Papaver* and Tobacco (Morphology, processing, uses and health hazards).

**Unit 10: Timber plants** **(2 lectures)**

General account with special reference to teak and pine.

**Unit 11: Fibers** **(3 lectures)**

Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).

**Practical**

1. **Cereals**: Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. **Sources of sugars and starches**: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
3. **Spices:** Black pepper (habit and sections).
4. **Beverages**: Tea (plant specimen, tea leaves)
5. **Sources of oils and fats**: Mustard–plant specimen, seeds; tests for fats in crushed seeds.
6. **Essential oil-yielding plants**: Habit sketch of *Rosa* and *Santalum* (specimens/ photographs).
7. **Rubber**: specimen, photograph/model of tapping, samples of rubber products.
8. **Drug-yielding plants**: Specimens of *Cannabis.*
9. **Tobacco**: specimen and products of Tobacco.
10. **Woods:** *Tectona*: Specimen, Section of young stem.
11. **Fiber-yielding plants**: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose.

**Suggested Readings**

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett Publishers.

## CC-7 Genetics

**(Credits: Theory-4, Practical-2**
**THEORY**
**Lectures: 40**

**Unit 1: Mendelian genetics and its extension (10 lectures)**
Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits.

**Unit 2: Extrachromosomal Inheritance (4 lectures)**
Chloroplast mutation: Variegation in Four o'clock plant; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in *Paramecium*.

**Unit 3: Linkage, crossing over and chromosome mapping (9 lectures)**
Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Sex Linkage.

**Unit 4: Variation in chromosome number and structure (6 lectures)**
Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

**Unit 5: Gene mutations (3 lectures)**
Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents).

**Unit 6: Fine structure of gene (3 lectures)**
Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism.

**Unit 7. Population and Evolutionary Genetics (5 lectures)**
Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

**Practical**

1. Meiosis through temporary squash preparation. Mendel's laws through seed ratios.
2. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
3. Blood Typing: ABO groups
4. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
5. Photographs/Permanent Slides showing Translocation Ring.
6. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Colour blindness.

### Suggested Readings


1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
4. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.


## SEC-1: Biofertilizers
**(Credits: 2)**
**THEORY**
**Lectures: 20**

**Unit 1:** General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. **(3 lectures)**

**Unit 2:** *Azotobacter*: classification, characteristics – crop response to a*zotobacter* inoculum, maintenance and mass multiplication. **(4 lectures)**

**Unit 3:** Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, blue green algae and *Azolla* in rice cultivation. **(3 lectures)**

**Unit 4:** Mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants. **(6 lectures)**

**Unit 5:** Organic farming – Green manuring and organic fertilizers, Recycling of bio-degradable agricultural wastes – biocompost making methods, types and method of vermicomposting – field Application. **(4 lectures)**

### Suggested Readings


1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.

## GE- 3: Plant Anatomy and Embryology

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1: Meristematic and permanent tissues** **(6 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** **(6 lectures)**

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

**Unit 4: Adaptive and protective systems** **(5 lectures)**

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

**Unit 5: Structural organization of flower** **(6 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** **(6 lectures)**

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

**Unit 7: Embryo and endosperm** **(5 lectures)**

Endosperm types, structure and functions; Dicot and monocot embryo

**Unit 8: Apomixis and polyembryony** **(2 lectures)**

Definition and types

### Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); (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. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
6. Structure of anther (young and mature), (Permanent slides).
7. Types of ovules: anatropous, orthotropous.
8. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).

**9.** Dissection of embryo/endosperm from developing seeds.

**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-V

## CC-11: Reproductive Biology of Angiosperm

**(Credits: Theory-4, Practical-2)**
**THEORY**
**Lectures: 40**

**Unit 1: Introduction** **(2 lectures)**
History and scope (contributions of W. Hofmeister, P. Maheshwari).

**Unit 2: Reproductive development** **(3 lectures)**
Induction of flowering; flower as a modified determinate shoot. Flower development.

**Unit 3: Anther and pollen biology** **(6 lectures)**
Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination.

**Unit 4: Ovule** **(8 lectures)**
Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type).

**Unit 5: Pollination and fertilization** **(3 lectures)**
Pollination types and significance; adaptations; path of pollen tube in pistil; double fertilization.

**Unit 6: Self incompatibility** **(8 lectures)**
Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination;

**Unit 7: Embryo, Endosperm and Seed** **(7 lectures)**
Structure and types; General pattern of development of dicot and monocot embryo and endosperm; Suspensor: structure and functions; Nutrition of embryo; Embryo development in *Paeonia*. Seed structure, importance and dispersal mechanisms

**Units 8: Polyembryony and apomixes** **(3 lectures)**

Introduction; Classification; Causes and applications.

## Practical

1. Anther: MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
3. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall(micrograph); Calculation of percentage of pollen germination in different media
4. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: (permanent slides/specimens/photographs).
5. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
7. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.

## Suggested Readings

1. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands
4. Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.

## CC-12: Plant Physiology

**(Credits: Theory-4, Practical-2)**

**Theory**

**Lectures: 40**

**Unit 1: Plant-water relations** **(8 lectures)**

Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration.

**Unit 2: Mineral nutrition** **(6 lectures)**

Essential and beneficial elements, macro and micronutrients, criteria for essentiality, mineral deficiency symptoms, roles of essential elements.

**Unit 3: Nutrient Uptake** **(7 lectures)**

Transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux.

**Unit 4: Translocation in the phloem** **(4 lectures)**

Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading.

**Unit 5: Plant growth regulators** **(7 lectures)**

Discovery and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene.

**Unit 6: Physiology of flowering** **(4 lectures)**

Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.

**Unit 7: Phytochrome, crytochromes and phototropins** **(4 lectures)**

Discovery, chemical nature, role in photomorphogenesis.

**Practical**

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.
3. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
4. To study the phenomenon of seed germination (effect of light).

**Demonstration experiments**

1. To demonstrate suction due to transpiration.
2. Rooting from cuttings (Demonstration).

**Suggested Readings**

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

## DSE-1: Analytical Techniques in Plant Sciences

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1: Imaging and related techniques** **(10 lectures)**

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; FISH, Transmission and Scanning electron microscopy.

**Unit 2: Cell fractionation** **(4 lectures)**

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient.

**Unit 3: Radioisotopes** **(2 lectures)**

Use in biological research, auto-radiography.

**Unit 4: Spectrophotometry** **(2 lectures)**

Principle and its application in biological research.

**Unit 5: Chromatography** **(4 lectures)**

Principle; Paper chromatography; Column chromatography, TLC.

**Unit 6: Characterization of proteins and nucleic acids** **(5 lectures)**

Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

**Unit 7: Biostatistics** **(13 lectures)**

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation.

**Practical**

1. Study of Blotting techniques: DNA fingerprinting, DNA sequencing, PCR through photographs.
2. To separate sugars by thin layer chromatography.
3. To estimate protein concentration through Lowry's methods.
4. Study of different microscopic techniques using photographs/micrographs, fluorescence and FISH).
5. Preparation of permanent slides (double staining).

**Suggested Readings**


1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw- Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.


**DSE-2: Bioinformatics**

**(Credits: Theory-4, Practical-2)**

**THEORY**

**Lectures: 40**

**Unit 1. Introduction to Bioinformatics (4 Lectures)**

Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

**Unit 2. Databases in Bioinformatics (3 Lectures)**

Introduction, Biological Databases, Classification format of Biological Databases.

**Unit 3. Biological Sequence Databases (16 Lectures)**

National Center for Biotechnology Information (NCBI): Tools and Databases of N CBI,

Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database.

EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.

DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ.

**Unit 4. Sequence Alignments** **(7 Lectures)**

Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW.

**Unit 5. Molecular Phylogeny** **(4 Lectures)**

Methods of Phylogeny, Software for Phylogenetic Analyses.

**Unit 6. Applications of Bioinformatics** **(6 Lectures)**

Structural Bioinformatics in Drug Discovery, Microbial genome applications, Crop improvement

**Practical**

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Construction of phylogenetic tree.

**Suggested Readings**

1. Ghosh Z. and Bibekanand M. (2008). Bioinformatics: Principles and applications. Oxford University Press.
2. Pevsner J. (2009). Bioinformatics and Functional Genomics. II Edition. Wiley- Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.

# Regular Course (Botany)

## Curriculum Structures for UG syllabus for B.Sc. Botany
## No. of papers =12+12=24, Total Credits= 120
## Total Marks=2100

| SEM-I | | | | | | |
|---|---|---|---|---|---|---|
| **Paper Code** | **Course** | **Credit** | **Credit Distribution (L+T+P)** | **End Sem Marks** | **Internal Marks** | **Total Marks** |
| BOT-101R | DSC-1A: Biodiversity (Microbes, Algae, Fungi and Archegoinate) | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| Paper-102R | DSC-2A | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| Paper-103R | DSC-3A | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| COMM-104HR | AEC: AECC-1: English/Hind/MIL (Communication) | 2 | 2+0+0 | 50 | - | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM-II | | | | | | |
|---|---|---|---|---|---|---|
| **Paper Code** | **Course** | **Credit** | **Credit Distribution (L+T+P)** | **End Sem Marks** | **Internal Marks** | **Total Marks** |
| BOT-201R | DSC-1B: Plant Ecology and Taxonomy | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| Paper-202R | DSC-2B | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| Paper-203R | DSC-3B | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| COMM-204HR | AEC: AECC-2: Environmental Science | 2 | 2+0+0 | 50 | - | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM-III | | | | | | |
|---|---|---|---|---|---|---|
| **Paper Code** | **Course** | **Credit** | **Credit Distribution (L+T+P)** | **End Sem Marks** | **Internal Marks** | **Total Marks** |
| BOT-301R | DSC-1C: Plant Anatomy and Embryology | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| Paper-302R | DSC-2C | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| Paper-303R | DSC-3C | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-304HR | AEC: SEC-1: Biofertilizers | 2 | 2+0+0 | 50 | - | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM-IV | | | | | | |
|---|---|---|---|---|---|---|
| **Paper Code** | **Course** | **Credit** | **Credit Distribution (L+T+P)** | **End Sem Marks** | **Internal Marks** | **Total Marks** |
| BOT-401R | DSC-1D: Plant Physiology and Metabolism | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| PAPER-402R | DSC-2D | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| PAPER-403R | DSC-3D | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-404HR | AEC: SEC-2: Mushroom culture and Technology | 2 | 2+0+0 | 50 | - | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM-V | | | | | | |
|---|---|---|---|---|---|---|
| **Paper Code** | **Course** | **Credit** | **Credit Distribution (L+T+P)** | **End Sem Marks** | **Internal Marks** | **Total Marks** |
| BOT-D1HR | DSE-1A: Analytical Techniques in Plant Sciences | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| PAPER-502R | DSE-2A | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| PAPER-503R | DSE-3A | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-504R | AEC: SEC-3: Medicinal Botany | 2 | 2+0+0 | 50 | - | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

| SEM-VI | | | | | | |
|---|---|---|---|---|---|---|
| **Paper Code** | **Course** | **Credit** | **Credit Distribution (L+T+P)** | **End Sem Marks** | **Internal Marks** | **Total Marks** |
| BOT-D2HR | DSE-1B: Bioinformatics | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| PAPER-602H | DSE-2B | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| PAPER-603R | DSE-3B | 6 | 4+0+2 | 60(Theo)+20(Pract) | 20 | 100 |
| BOT-604R | AEC: SEC-4: Nursery and Gardening | 2 | 2+0+0 | 50 | - | 50 |
| **Total** | | **20** | **20** | **290** | **60** | **350** |

## 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 (Two)**

**DSE 1:** Analytical Techniques in Plant Sciences
**DSE 2:** Bioinformatics

**Ability Enhancement Compulsory Courses**

3. Environmental Science
4. English/MIL Communication

**Skill Enhancement Courses (Four)**

**Botany**

**SEC 1:** Biofertilizers

**SEC 2:** Nursery and Gardening

**SEC 3:** Medicinal Botany

**SEC 4:** Mushroom Culture Technology

## Semester-I

### DSC-1A: Biodiversity (Microbes, Algae, Fungi and Archegoniate)
**(Credits: Theory-4, Practicals-2)**

**THEORY**
**Lectures: 40**

**Unit 1: Microbes** **(6 Lectures)**

Viruses – Discovery, general structure, replication (general account); Economic importance; Bacteria– Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

**Unit 2: Algae** **(9 Lectures)**

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

**Unit 3: Fungi** **(9 Lectures)**

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; 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** (**1 Lectures)**
Unifying features of archegoniates, Transition to land habit, Alternation of generations.

**Unit 5: Bryophytes** **(6 Lectures)**
General characteristics, Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

**Unit 6: Pteridophytes** **(5 Lectures)**
General characteristics, classification, Early land plants (*Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum.* Heterospory and seed habit. Ecological and economical importance of Pteridophytes.

**U nit 7: Gymnosperms** **(4 Lectures)**
General characteristics. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. Ecological and economical importance.

**Practical**

1. EMs/Models of viruses – T-Phage and TMV.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc, Chlamydomonas* (electron micrographs), *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. *Puccinia*: Herbarium specimens and permanent slides
7. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus.*
8. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose).
9. ***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).
10. ***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).

19. ***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).
20. ***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).

**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.

## Semester- III

## DSC-1C: Plant Anatomy and Embryology
**(Credits: Theory-4, Practicals-2)**

**THEORY**
**Lectures: 40**

**Unit 1: Meristematic and permanent tissues** **(6 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** **(6 Lectures)**
Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

**Unit 4: Adaptive and protective systems** **(5 Lectures)**
Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

**Unit 5: Structural organization of flower** **(6 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** **(6 Lectures)**
Pollination mechanisms and adaptations; Double fertilization; Seed- dispersal mechanisms.

**Unit 7: Embryo and endosperm** **(5 Lectures)**
Endosperm types, structure and functions; Dicot and monocot embryo.

**Unit 8: Apomixis and polyembryony** (**2 Lectures)**

Definition and types.

**Practical**

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma) (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. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
6. Structure of anther (young and mature) (Permanent slides).
7. Types of ovules: anatropous, orthotropous.
8. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
9. Dissection of embryo/endosperm from developing seeds.

**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.

## SEC-1: Biofertilizers
**(Credits 2) Lectures: 20**

**Unit 1:** **(3 Lectures)**
General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

**Unit 2:** **(4 Lectures)**
*Azospirillum:* classification, characteristics – crop response to *Azotobacter* inoculum, maintenance and mass multiplication.

**Unit 3:** **(4 Lectures)**
Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, nitrogen fixation, blue green algae and *Azolla* in rice cultivation.

**Unit 4:** **(6 Lectures)**
Mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

**Unit 5:** **(4 Lectures)**
Organic farming – Green manuring and organic fertilizers, Recycling of bio- degradable, agricultural wastes – biocompost making methods, types and method of vermicomposting – field Application.

### Suggested Readings

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

## Semester-V

## SEC-3: Medicinal Botany
**(Credits 2) Lectures: 20**

**Unit 1:** **(6 Lectures)**

History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, plants used in Siddha medicine. Unani: History, concept.

**Unit 2:** **(8 Lectures)**

Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens. Propagation of Medicinal Plants:

**Unit 3:** **(6 Lectures)**

Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Applications of Ethnobotany: folk medicines of ethnobotany, ethnomedicine, ethnoecology, Application of natural products to certain diseases- Jaundice, diabetics, Blood pressure and skin diseases.

**Suggested Readings**

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

## DSE-1 A: Analytical Techniques in Plant Sciences
**(Credits: Theory-4, Practicals-2)**

**THEORY**
**Lectures: 40**

**Unit 1: Imaging and related techniques** **(10 Lectures)**

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; FISH; Transmission and Scanning electron microscopy.

**Unit 2: Cell fractionation** **(4 Lectures)**

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient.

**Unit 3: Radioisotopes**

Use in biological research, auto-radiography. **(2 Lectures)**

**Unit 4: Spectrophotometry**

Principle and its application in biological research. **(2 Lectures)**

**Unit 5: Chromatography** **(4 Lectures)**

Principle; Paper chromatography; Column chromatography, TLC.

**Unit 6: Characterization of proteins and nucleic acids (5 Lectures)**

Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

**Unit 7: Biostatistics (13 Lectures)**

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation.

## Practicals

1. Study of Blotting techniques: DNA fingerprinting, DNA sequencing, PCR through photographs.
2. To estimate protein concentration through Lowry's methods.
3. Study of different microscopic techniques using photographs/micrographs, fluorescence and FISH).
4. Preparation of permanent slides (double staining).

## Suggested Readings

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw- Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.
3. Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.