

# **Choice Based Credit System**

## **Syllabus**

**For**

**B. Sc. Botany (Regular)**



**DEPARTMENT OF BOTANY  
GAUHATI UNIVERSITY  
GUWAHATI-781014**

Effective from Academic Session 2019-2020

**Scheme for Choice Based Credit System in B. Sc. with Botany (Regular)**

	<b>DISCIPLINE CORE COURSE (12)</b>	<b>Ability Enhancement Compulsory Course (AECC) (2)</b>	<b>Skill Enhancement Course (SEC) (2)</b>	<b>Discipline Specific Elective DSE (6)</b>
I	Discipline-1 Botany Paper I: Biodiversity (Microbes, Algae, Fungi and Archegoniate)	English/MIL Communication		
II	Discipline-1 Botany Paper II: Plant Ecology and Taxonomy	Environmental Studies		
III	Discipline-1 Botany Paper III: Plant Anatomy and Embryology		SEC-1	
IV	Discipline-1 Botany Paper IV: Plant Physiology and Metabolism		SEC -2	
V			SEC -3	DSE-Botany Paper I
VI			SEC -4	DSE-Botany Paper II

## Course Structure for CBCS in B. Sc. with Botany (Regular) as per requirement of UGC

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	ENG-AE 1014	English/MIL communications	4
	BOT-RC-1016	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4
	BOT-RC-1016 (Practical)	Biodiversity (Microbes, Algae, Fungi and Archegoniate) –Practical	2
II	ENV-AE 2014	Environmental Studies	4
	BOT-RC-2016	Plant Ecology and Taxonomy	4
	BOT-RC-2016 (Practical)	Plant Ecology and Taxonomy -Practical	2
III	BOT-RC-3016	Plant Physiology and Metabolism	4
	BOT-RC-3016 (Practical)	Plant Physiology and Metabolism –Practical	2
	1. BOT- SE-3014 2. BOT-SE-3024	RSE-1 (Any one) 1. Biofertilizers 2. Herbal Technology	4
IV	BOT-RC-4016	Plant Anatomy and Embryology	4
	BOT-RC-4016( Practical)	Plant Anatomy and Embryology-Practical	2
	1. BOT-SE-4014 2. BOT-SE-4024 3. BOT-SE-4034	RSE -2 (Any one) 1. Nursery and Gardening 2. Floriculture 3. Intellectual Property Right	4
V	1. BOT-SE-5014 2. BOT-SE-5024	RSE -3 Any one) 1. Medicinal Botany 2. Plant Diversity and Human Welfare	4
	1. BOT-RE-5016 2. BOT-RE-5026 3. BOT-RE-5036	RDS- I (any one) 1. Cell and Molecular Biology 2. Economic Botany and Biotechnology 3. Genetics and Plant Breeding	4
	RDS -1( Practical)	RDS-Botany Paper I –Practical	2
	VI	1. BOT-SE-6014 2. BOT-SE-6024 RDS -Either of 1 or 2 below:	RSE -4 (Any one)  1. Ethnobotany 2. Mushroom Culture Technology

1. BOT-RE-6016	RDS-2 (Any one) 1. Analytical Techniques in Plant Sciences	4	6
1. BOT-RE-6016 (Practical)	2. Analytical Techniques in Plant Sciences -Practical	2	
2. BOT-RE-6026	2. Dissertation	6	
<b>Total Credits in Botany</b>			<b>52</b>

**Legends:**

RC: Core Papers

RE: Discipline Specific Elective Papers

SE: Skill Enhancement Papers

## List of Papers with BSc. Botany (Regular) under CBCS

### Core Papers

1	BOT-RC-1016	: Biodiversity (Microbes, Algae, Fungi and Archegoniate)
2	BOT-RC-2016	: Plant Ecology and Taxonomy
3	BOT-RC-3016	: Plant Physiology and Metabolism
4	BOT-RC-4016	: Plant Anatomy and Embryology

### Discipline Specific Elective Papers (Any two)

1	BOT-RE-5016	: Cell and Molecular Biology
2	BOT-RE-5026	: Economic Botany and Biotechnology
3	BOT-RE-5036	: Genetics and Plant Breeding
4	BOT-RE-6016	: Analytical Techniques in Plant Sciences
5	BOT-RE-6026	: Dissertation

### Ability Enhancement Compulsory Courses

1	ENG-AE-1014	: English/MIL
2	ENV-AE-2014	: Environmental Studies

### Skill Enhancement Papers (Any four)

1	BOT-SE-3014	: Biofertilizers
2	BOT-SE-3024	: Herbal Technology
3	BOT-SE-4014	: Nursery and Gardening
4	BOT-SE-4024	: Floriculture
5	BOT-SE-4034	: Intellectual Property Right
6	BOT-SE-5014	: Medicinal Botany
7	BOT-SE-5024	: Plant Diversity and Human Welfare
8	BOT-SE-6014	: Ethnobotany
9	BOT-SE-6024	: Mushroom Culture Techniques

## Core Courses

# Semester-I

1

**BOT-RC-1016**

**Biodiversity (Microbes, Algae, Fungi and Archegoniate)**

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

## **1.1 Theory**

### **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; 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; 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 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, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* 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, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), 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. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

## 1.2 Practical

- 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; 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.
- 5 *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.

- 6 *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.
- 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 Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
- 10 *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).
- 11 *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
- 12 *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).
- 13 *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).
- 14 *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).
- 15 *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).
- 16 *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.

2

BOT-RC-2016

## Plant Ecology and Taxonomy

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

### 2.1 Theory

**Unit 1 : *Introduction*** (2 Lectures)

**Unit 2 : *Ecological factors*** (10 Lectures)

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.

**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 and Phosphorous

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

Principal 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: single access and multi-access

**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, rejection of names, principle of priority and its limitations.

**Unit 11 : *Classification* (6 Lectures)**

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

**Unit 12 : *Biometrics, numerical taxonomy and cladistics* (4 Lectures)**

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

## **2.1 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. Study of morphological adaptations of hydrophytes and xerophytes (four each).

3. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
4. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
5. 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, Solanaceae, Lamiaceae.
6. Mounting of a properly dried and pressed specimen of any 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.

3

## BOT-RC-3016 Plant Physiology and Metabolism

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

### 3.1 Theory

#### **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; C<sub>3</sub>, C<sub>4</sub> 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.

### 3.2 Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of light on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency.
4. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
5. To study the effect of bicarbonate concentration on O<sub>2</sub> evolution in photosynthesis.

### Demonstration experiments

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

4

BOT-RC-4016

## Plant Anatomy and Embryology

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

### 4.1 Theory

**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.

## **4.2 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 (Hydrilla stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous (permanent slides)
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.

### **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.

## Discipline Specific Elective Papers

Two (2) be selected from each of the three disciplines

# 1

BOT-RE-5016

## Cell and Molecular Biology

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

### 1.1 Theory

#### **Unit 1: *Techniques in Biology***

**(8 Lectures)**

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

#### **Unit 2 : *Cell as a unit of Life***

**(2 Lectures)**

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

#### **Unit 3 : *Cell Organelles***

**(20 Lectures)**

Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA.

Chloroplast Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA.

ER, Golgi body & Lysosomes: Structures and roles.

Peroxisomes and Glyoxisomes: Structures, composition, functions in animals and plants and biogenesis.

Nucleus: Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular

organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief).

**Unit 4 : *Cell Membrane and Cell Wall* (6 Lectures)**

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

**Unit 5 : *Cell Cycle* (6 Lectures)**

Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

**Unit 6 : *Genetic material* (6 Lectures)**

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material.

DNA replication (Prokaryotes and eukaryotes ): bidirectional replication , semi-conservative, semi discontinuous RNA priming ,  $\theta$  (theta) mode of replication , replication of linear , ds-DNA, replicating the 5' end of linear chromosome including replication enzymes.

**Unit 7 : *Transcription (Prokaryotes and Eukaryotes)* (6 Lectures)**

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.

**Unit 8 : *Regulation of gene expression* (6 Lectures)**

Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.

## **1.2 Practical**

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
2. Study of the photomicrographs of cell organelles.
3. To study the structure of plant cell through temporary mounts.
4. Study of mitosis and meiosis (temporary mounts and permanent slides).
5. Study of plasmolysis and deplasmolysis on Rhoeo leaf.

6. Measure the cell size (either length or breadth/diameter) by micrometry.
7. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
8. Study DNA packaging by micrographs.
9. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

### Suggested Readings

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. 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.

## 2

BOT-RE-5026

### Economic Botany and Biotechnology

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

#### 2.1 Theory

**Unit 1 : *Origin of Cultivated Plants*** (4 Lectures)

Concept of centres of origin, their importance with reference to Vavilov's work

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

Wheat -Origin, morphology, uses

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

General account with special reference to Gram and soybean

**Unit 4 : *Spices*** (4 Lectures)

General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)

**Unit 5 : *Beverages*** (2 Lectures)

Tea (morphology, processing, uses)

**Unit 6 : *Oils and Fats*** (2 Lectures)

General description with special reference to groundnut

**Unit 7 : *Fiber Yielding Plants* (2 Lectures)**

General description with special reference to Cotton (Botanical name, family, part used, morphology and uses).

**Unit 8 : *Introduction to biotechnology* (2 lecture)**

**Unit 9 : *Plant tissue culture* (8 Lectures)**

Micro propagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

**Unit 10 : *Recombinant DNA Techniques* (18 Lectures)**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

**Unit 11 : *Bioinformatics* (5 Lectures)**

Introduction, branches, Aim, Scope and research areas, Biological data base and the retrieval system.

**Unit 12 : *Applications of Bioinformatics* (5 Lectures)**

Molecular Phylogeny; Basics in Proteomics and Genomics and their applications in crop improvement, Drug Discovery.

## **2.2 Practical**

1. Study of economically important plants : Rice, Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut, Curcuma, through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.
5. Data base searching, and retrieval of Sequence from databases.
6. Sequence alignment, Homology and construction of Phylogenetic tree.

## Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
4. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
5. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley Blackwell.
6. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. \_II Edition. Benjamin Cummings.

# 3

## BOT-RE-5036 Genetics and Plant Breeding

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

### 3.1 Theory

#### Unit 1 : Heredity

(20 Lectures)

1. Brief life history of Mendel
2. Terminologies
3. Laws of Inheritance
4. Modified Mendelian Ratios: 2:1- lethal Genes; 1:2:1- Co- dominance, incomplete dominance; 9:7; 9:4:3; 13:3; 12:3:1.
5. Chi Square
6. Pedigree Analysis
7. Cytoplasmic Inheritance: Shell Coiling in Snail, Kappa particles in Paramecium, leaf variegation in *Mirabilis jalapa*, Male sterility.
8. Multiple allelism
9. Pleiotropism
10. Chromosome theory of Inheritance.

#### Unit 2 : Sex-determination and Sex-linked Inheritance

(4 Lectures)

#### Unit 3 : *Linkage and Crossing over*

(8 Lectures)

Linkage: concept & history, complete & incomplete linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps based on two and three factor crosses.

Crossing over: concept and significance, cytological proof of crossing over.

**Unit 4 : *Mutations and Chromosomal Aberrations* (4 Lectures)**

Types of mutations, effects of physical & chemical mutagens. Numerical chromosomal changes: Euploidy, Polyploidy and Aneuploidy ; Structural chromosomal changes: Deletions, Duplications, Inversions & Translocations.

**Unit 5 : *Plant Breeding* (4 lectures)**

Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

**Unit 6 : *Methods of crop improvement* (8 lectures)**

Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

**Unit 7 : *Quantitative inheritance* (4 lectures)**

Concept, mechanism, examples. Monogenic vs polygenic Inheritance.

**Unit 8 : *Inbreeding depression and heterosis* (4 lectures)**

History, genetic basis of inbreeding depression and heterosis; Applications.

**Unit 9 : *Crop improvement and breeding* (4 lectures)**

Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement.

## 3.2 Practical

1. Mendel's laws through seed ratios. Laboratory exercises in probability and chi- square.
2. Chromosome mapping using point test cross data.
3. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
4. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs.
5. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
6. Hybridization techniques - Emasculation, Bagging (For demonstration only).
7. Induction of polyploidy conditions in plants (For demonstration only).

### Suggested Readings

1. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India.
2. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
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.
5. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
6. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
7. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
8. Acquaah, G. (2007). Principles of Plant Genetics & Breeding. Blackwell Publishing.

# 4

## BOT-RE-6016

### Analytical Techniques in Plant Sciences

Total Lectures : 60 Credits : 6 (Theory - 4, Practical - 2)

#### 4.1 Theory

**Unit 1 : *Imaging and related techniques* (15 Lectures)**

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

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

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl<sub>2</sub> gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

**Unit 3 : *Radioisotopes* (4 Lectures)**

Use in biological research, auto-radiography, pulse chase experiment.

**Unit 4: *Spectrophotometry* (4 Lectures)**

Principle and its application in biological research.

**Unit 5 : Chromatography****(8 Lectures)**

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

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

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

**Unit 7 : Biostatistics****(15 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; Chi-square test for goodness of fit.

**4.2 Practicals**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate sugars by thin layer chromatography.
4. Isolation of chloroplasts by differential centrifugation.
5. To separate chloroplast pigments by column chromatography.
6. To estimate protein concentration through Lowry's methods.
7. To separate proteins using PAGE.
8. To separate DNA (marker) using AGE.
9. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).

## 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.

5

**BOT-RE-6026**

**Dissertation**

Credits : 6

## Skill Enhancement Papers (Any four)

1

## BOT-SE-3014

### Biofertilizers

Total Lectures : 60 Credits : 4

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

(8 Lectures)

**Unit 2:** Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

(16 Lectures)

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

(8 Lectures)

**Unit 4:** Mycorrhizal association, types of 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.

(16 Lectures)

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

(12 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

## 2

### BOT-SE-3024 Herbal Technology

Total Lectures : 60 Credits : 4

**Unit 1:** Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

(12 Lectures)

**Unit 2:** Pharmacognosy - systematic position and medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

(12 Lectures)

**Unit 3:** Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withania somnifera* (drugs acting on nervous system), *Clerodendron phlomoides* (anti-rheumatic) and *Centella asiatica* (memory booster).

(12 Lectures)

**Unit 4:** Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

(16 Lectures)

**Unit 5:** Medicinal plant banks micro propagation of important species (*Withania somnifera*, neem and tulsi- Herbal foods-future of pharmacognosy)

(8 Lectures)

### Suggested Readings

1. Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2. The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Book Distributors.
3. Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4. Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
5. Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6. Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7. Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

# 3

## BOT-SE-4014 Nursery and Gardening

Total Lectures : 60 Credits : 4

**Unit 1:** Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

(8 Lectures)

**Unit 2:** Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.

(12 Lectures)

**Unit 3:** Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glass house.

(12 Lectures)

**Unit 4:** Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

(16 Lectures)

**Unit 5:** Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

(12 Lectures)

### Suggested Readings

1. Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.

4

## BOT-SE-4024

### Floriculture

Total Lectures : 60 Credits : 4

**Unit 1:** Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.

(4 Lectures)

**Unit 2:** Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching; Topiary; Role of plant growth regulators.

(16 Lectures)

**Unit 3:** Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.

(8 Lectures)

**Unit 4:** Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India.

(8 Lectures)

**Unit 5:** Landscaping Places of Public Importance: Landscaping highways and Educational institutions.

(8 Lectures)

**Unit 6:** Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliium, Orchids).

(12 Lectures)

**Unit 7:** Diseases and Pests of Ornamental Plants.

(4 Lectures)

### Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

# 5

BOT-SE-4034

## Intellectual Property Rights

Total Lectures : 60 Credits : 4

**Unit 1 : *Introduction to intellectual property right (IPR)* (4 lectures)**

Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

**Unit 2 : *Patents* (6 Lectures)**

Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

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

Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

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

Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.

**Unit 5: *Geographical Indications* (6 Lectures)**

Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position.

**Unit 6 : *Protection of Traditional Knowledge* (8 Lectures)**

Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Propecting and Bio-Piracy, Alternative ways, Protectability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

**Unit 7 : *Industrial Designs* (4 Lectures)**

Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

**Unit 8 : *Protection of Plant Varieties* (4 Lectures)**

Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India. Rights of farmers, Breeders and Researchers. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001.

**Unit 9 : *Information Technology Related Intellectual Property Rights* (8 Lectures)**

Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection

**Unit 10 : *Biotechnology and Intellectual Property Rights.* (8 Lectures)**

Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

## Suggested Readings

1. N.K. Acharya: Textbook on intellectual property rights, Asia Law House (2001).
2. Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).
3. P. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata McGraw-Hill (2001).
4. Arthur Raphael Miller, Micheal H.Davis; Intellectual Property: Patents, Trademarks and Copyright in a Nutshell, West Group Publishers (2000).
5. Jayashree Watal, Intellectual property rights in the WTO and developing countries, Oxford University Press, Oxford.

# 6

## BOT-SE-5014 Medicinal Botany

Total Lectures : 60 Credits : 4

**Unit 1:** History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.

(20 Lectures)

**Unit 2:** 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, Ethnomedicinal plant Gardens. Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.

(20 Lectures)

**Unit 3:** Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

(20 Lectures)

## 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.

7

**BOT-SE-5024**

## **Plant Diversity and Human Welfare**

Total Lectures : 60 Credits : 4

**Unit 1:** Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at theecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.

(16 Lectures)

**Unit 2:** Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management- Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

(16 Lectures)

**Unit 3:** Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

(16 Lectures)

**Unit 4:** Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.

(12 Lectures)

## Suggested Readings

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi

# 8

## BOT-SE-6014 Ethnobotany

Total Lectures : 60 Credits : 4

### **Unit 1 : *Ethnobotany* (12 Lectures)**

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

### **Unit 2: *Methodology of Ethnobotanical studies* (12 Lectures)**

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

### **Unit 3 : *Role of ethnobotany in modern Medicine* (20 Lectures)**

Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) a) *Azadirachta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*. Role of ethnobotany in modern medicine with special example *Rauvolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*.

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

#### **Unit 4 : *Ethnobotany and legal aspects***

(16 Lectures)

Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

#### **Suggested Readings**

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- 3) Lone et al., Palaeoethnobotany
- 4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
- 5) S.K. Jain, 1990. Contributions of Indian ethnobotny. Scientific publishers, Jodhpur.
- 6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester
- 7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India. Botanical Survey of India. Howrah. 8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996 9)

# 9

## BOT-SE-6024 Mushroom Culture Technology

Total Lectures : 60 Credits : 4

**Unit 1:** Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.

(10 Lectures)

**Unit 2:** Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation

- Low cost technology, Composting technology in mushroom production.

(24 Lectures)

**Unit 3:** Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

(16 Lectures)

**Unit 4:** Food Preparation : Types of foods prepared from mushroom. Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

(10 Lectures)

## Suggested Readings

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

## Appendix

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	Ability Enhancement Compulsory Course-I	English/MIL communications/ Environmental Science	4
	Core course - Botany Paper I	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	4
	Core Course - Paper I Practical/Tutorial	Biodiversity (Microbes, Algae, Fungi and Archegoniate) Lab	2
	Discipline- 2 Paper I	DSC- 2 Paper I	4
	Discipline- 2 Paper I Practical	DSC- 2 Paper I Practical	2
	Discipline - 3 Paper I	DSC- 3 Paper I	4
	Discipline - 3 Paper I Practical	DSC- 2 Paper I Practical	2
II	Ability Enhancement Compulsory Course-II	English/MIL communications/ Environmental Science	4
	Core course-Botany Paper II	Plant Ecology and Taxonomy	4
	Core Course- Botany Paper II Practical/Tutorial	Plant Ecology and Taxonomy Lab	2
	Discipline - 2 Paper II	DSC- 2 Paper 2	4
	Discipline -2 Paper II Practical	DSC- 2 Paper 2 Practical	2
	Discipline - 3 Paper II	DSC- 3 Paper 2	4
	Discipline - 3 Paper II Practical	DSC- 3 Paper 2 Practical	2
III	Core course- Botany Paper III	Plant Anatomy and Embryology	4
	Core Course- Botany Paper III Practical/Tutorial	Plant Anatomy and Embryology Practical	2
	Discipline - 2 Paper III	DSC- 2 Paper III	4
	Discipline - 2 Paper III Practical	DSC- 2 Paper III Practical	2
	Discipline - 3 Paper III	DSC- 3 Paper III	4
	Discipline - 3 Paper III Practical	DSC- 3 Paper III Practical	4
	Skill Enhancement Course -1	SEC-1	4
IV	Core course- Botany Paper IV	Plant Physiology and Metabolism	4
	Course- Botany Paper IV Practical	Plant Physiology and Metabolism Practical	2
	Discipline - 2 Paper IV	DSC- 2 Paper IV Theory	4

	Discipline - 2 Paper IV Practical	DSC- 2 Paper IV Practical	2
	Discipline - 3 Paper IV	DSC- 3 Paper IV Theory	4
	Discipline - 3 Paper IV Practical	DSC- 3 Paper IV	2
	Skill Enhancement Course -2	SEC -2	4
V	Skill Enhancement Course -3	SEC -3	4
	Discipline Specific Elective –Botany Paper I	DSE-Botany Paper I	4
	Discipline Specific Elective –Botany Paper I Practical	DSE-Botany Paper I Practical	2
	Discipline Specific Elective – Discipline 2 Paper I	DSE-Discipline 2 Paper I	4
	Discipline Specific Elective – Discipline 2 Paper I Practical	DSE-Discipline 2 Paper I Practical	2
	Discipline Specific Elective – Discipline 3 Paper I	DSE- Discipline 3 Paper I	4
	Discipline Specific Elective – Discipline 3 Paper I Practical	DSE-Discipline 2 Paper I Practical	2
VI	Skill Enhancement Course -4	SEC -4	4
	Discipline Specific Elective –Botany Paper II	DSE-Botany Paper II	4
	Discipline Specific Elective –Botany Paper II Practical	DSE-Botany Paper II Practical	2
	Discipline Specific Elective – Discipline 2 Paper II	DSE-Discipline 2 Paper II	6
	Discipline Specific Elective – Discipline 2 Paper II Practical	DSE-Discipline 3 Paper II Practical	6
	Discipline Specific Elective – Discipline 3 Paper II	DSE- Discipline 3 Paper II	6
	Discipline Specific Elective – Discipline 3 Paper II Practical	DSE- Discipline 3 Paper II Practical	6
<b>Total Credits</b>			<b>132</b>

## **B.Sc. Botany Regular**

### **Course Outcomes**

#### **Core Papers**

##### **BOT-RC-1016 : Biodiversity (Microbes, Algae, Fungi and Archegoniate)**

- CO1. Understand the origin, structure, reproduction pattern and economic importance of virus and bacteria
- CO2. Knowledge on characteristics features, classifications, reproductive mechanisms, life cycle pattern and ecology of different genera of algae and fungi
- CO3. Understand the importance/significance and mechanism of symbiotic associations of algae-fungi and fungi-higher plants
- CO4. Knowledge on archegoniate and alternation of generations
- CO5. Knowledge on classifications, reproductive mechanisms, ecology, evolution and economic significances of bryophyte, pteridophyte and gymnosperm
- CO6. Knowledge on T phage and TMV, lytic and lysogenic cycles of viruses
- CO7. Know about different types of bacteria, their structure and reproduction types, gram staining procedures
- CO8. Knowledge on morphology, anatomy and reproductive structures of different general of algae, fungi, bryophytes, pteridophyte and gymnosperms

##### **BOT-RC-2016 : Plant Ecology and Taxonomy**

- CO1. Basic knowledge on Ecology, Know about ecological factors, law of tolerance, Adaptation of hydrophytes and xerophytes
- CO2. Knowledge on plant communities and its characteristics, processes and types of succession
- CO3. Understanding concept of ecosystem and its structure, knowledge on production and productivity in ecological pyramids, biogeochemical cycles of Carbon, Nitrogen and Phosphorus
- CO4. Knowledge on phytogeography and principle of biogeographical zones of India
- CO5. Knowledge on plant taxonomy, its identification, Classification and Nomenclature
- CO6. Understanding on plant Identification, importance of herbarium and botanical gardens of the world and India, documentation and Keys
- CO7. Knowledge on taxonomic evidences from palynology, cytology, phytochemistry and molecular data, understanding about taxonomic hierarchy such as ranks, categories and taxonomic groups
- CO8. Knowledge on Botanical nomenclature, binominal system Principles and rules (ICN), classifications and types of classification
- CO9. Knowledge on characters used in taxonomy and variations of biometrics, numerical taxonomy and cladistics
- CO10. Practical Knowledge on ecological instruments such as Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter
- CO11. Practical knowledge on determination of minimal quadrat size for the study of herbaceous vegetation by species area curve method
- CO12. Practical knowledge on Quantitative analysis of herbaceous vegetation for frequency and comparison

with Raunkiaer's frequency distribution law

CO13. Practical knowledge on vegetative and floral characters of plant family Brassicaceae, Solanaceae and Lamiaceae

CO14. Hands on preparation of herbarium sheet with proper mounting and pressing of dried wild plant specimen

### **BOT-RC-3016 : Plant Physiology and Metabolism**

CO1. Knowledge on different types of plant-water relationship, their significance and factors

CO2. Knowledge on different mineral nutrients, their roles on plants, different types of transport and their mechanisms, knowledge on different carriers, channels and pumps

CO3. Understanding phloem loading and unloading, pressure flow model

CO4. Knowledge on different types of photosynthetic pigments, Photosystem I and II, electron transport and mechanism of ATP synthesis, different types of pathways of photorespiration and carbon fixation

CO5. Basic knowledge on different pathways of respiration

CO6. Knowledge on structure and properties of enzyme and their catalysis and inhibition mechanisms

CO7. Knowledge on biological nitrogen fixation and metabolism

CO8. Knowledge on discovery and physiological roles of different plant growth regulators, Understanding plant responses to light and temperature

CO9. Knowledge on estimation of osmotic potential, Understanding on effects of light on transpiration, Basic idea on stomatal index and frequency, knowledge on enzyme activity and effect of pH, Knowledge on bicarbonate concentration and O<sub>2</sub> evolution in photosynthesis of some plants

CO10. Understanding on Bolting, RQ and root respiration, Knowledge on auxin's role on rooting, basic idea on transpiration suction

### **BOT-RC-4016 : Plant Anatomy and Embryology**

CO1. Understand the meristematic and permanent tissue of plants

CO2. Knowledge on the structure of monocot and dicot root, stem and leaf

CO3. Basic knowledge on vascular cambium, secondary growth in root and stem

CO4. Knowledge on epidermis, cuticle, stomata, adaptation in xerophytes and helophytes

CO5. Knowledge on the structure of anther and pollen, structure and types of ovules, types of embryo sacs, organization and ultrastructure of mature embryo sac

CO6. Understand the mechanism of pollination and adaptations, double fertilization, seed structure, and dispersal mechanism

CO7. Knowledge on endosperm types, structure, functions, and embryo-endosperm relationship

CO8. Basic knowledge on apomixis, polyembryony and their applications

CO9. Knowledge on meristems, parenchyma, collenchyma, sclerenchyma, xylem, phloem, anatomy of root, stem, and leaf, adaptations in xerophytes, helophytes, structure of anther, types of ovules, female gametophyte, pollination, seed dispersal embryo and endosperm

## **Discipline Specific Elective Papers**

### **BOT-RE-5016 : Cell and Molecular Biology**

- CO1. Understand the basic principle, function and working of microscopy used in research
- CO2. Learn about the basics of cell and cell theory
- CO3. Learn about the structure, composition and function of different cell organelles
- CO4. Understand the structure and functions of cell membrane, membrane proteins and carbohydrates, membrane permeability and cell wall
- CO5. Learn about cell cycle and its regulation at molecular level
- CO6. Knowledge on history of DNA discovery, experiments related to DNA as the genetic material, structure and types of DNA and different modes of replication
- CO7. Learn about types and structure of RNA, various types of RNA polymerases, basic knowledge on prokaryotic and eukaryotic translation and genetic code
- CO8. Understand about regulation of gene expression in prokaryotes and eukaryotes
- CO9. Practical knowledge on prokaryotic cells (bacteria), viruses and eukaryotic cells with the help of light and electron micrographs
- CO10. Practical knowledge on photomicrographs of cell organelles
- CO11. Practical knowledge on the structure of plant cell through temporary mounts
- CO12. Practical knowledge on mitosis and meiosis
- CO13. Practical knowledge on plasmolysis and deplasmolysis
- CO14. Practical knowledge on micrometry
- CO15. Understand the structure of nuclear pore complex by photograph and learn about special chromosomes either by slides or photographs.
- CO16. Practical knowledge on micrograph study of DNA packaging
- CO17. Practical knowledge on karyotype and ideogram preparation

### **BOT-RE-5026 : Economic Botany and Biotechnology**

- CO1. Learn about the centres of origin of cultivated plants with special reference to Vavilov's work
- CO2. Learn about the origin, morphology and uses of cereals
- CO3. Understand about legumes with special reference to Gram and soybean
- CO4. Learn about botanical name, family, part used, morphology and uses of spices with special reference to clove and black pepper
- CO5. Knowledge on morphology, processing and uses of tea

- CO6. Learn about fats and oils with special reference to groundnut
- CO7. Knowledge on botanical name, family, parts used, morphology and uses of fiber yielding plants with special reference to cotton
- CO8. A brief knowledge on biotechnology
- CO9. Knowledge on plant tissue culture techniques
- CO10. Learn about blotting techniques, DNA fingerprinting, molecular markers, DNA sequencing and types of PCR. Knowledge on hybridoma technology, ELISA, molecular diagnosis of human disease, and human gene Therapy
- CO11. Understand the aim, scope and branches of bioinformatics, repositories of Biological Data Knowledge and retrieval system
- CO12. Learn about molecular phylogeny, basics in proteomics and genomics and their applications in crop improvement and drug discovery

### PRACTICAL

- CO13. Practical knowledge on economically important plants through specimens, sections and microchemical tests
- CO14. Practical knowledge on basic equipments used in tissue culture
- CO15. Understand anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation through photograph
- CO16. Practical knowledge on molecular techniques
- CO17. Practical knowledge on data base searching, and retrieval of Sequence from databases
- CO18. Practical knowledge on sequence alignment, Homology and Phylogenetic tree

### **BOT-RE-5036 : Genetics and Plant Breeding**

- CO1. Understand laws of inheritance, modified mendelian ratios, chi square, pedigree analysis, cytoplasmic inheritance, multiple allelism, pleiotropism and chromosomal theory of inheritance.
- CO2. Understand basics of sex determination and sex-linked inheritance
- CO3. Learn about types of linkage, bridges experiment, coupling & repulsion, recombination frequency, linkage maps, crossing over and cytological proof of crossing over
- CO4. Knowledge on types of mutation, mutagens, numerical and structural chromosomal changes
- CO5. Learn about basics of plant breeding, important achievements and undesirable consequences of plant breeding
- CO6. Learn about centres of origin and domestication of crop plants, plant genetic resources; acclimatization, selection methods, hybridization procedure, advantages and limitations

CO7. Understand the concept and mechanism of quantitative inheritance

CO8. Understand genetic basis of inbreeding depression and heterosis.

CO9. Learn about role of mutations, polyploidy, distant hybridization and role of biotechnology in crop improvement.

#### PRACTICAL

CO10. Practical knowledge on Mendel's law

CO11. Practical knowledge on chromosome mapping using point test cross data

CO12. Practical knowledge on incomplete dominance and gene interaction

CO13. Knowledge of aneuploidy: Down's, Klinefelter's and Turner's syndromes through photographs

CO14. Practical knowledge of Translocation Ring, Laggards and Inversion Bridge

CO15. Practical knowledge of hybridization technique

CO16. Practical knowledge on induction of polyploidy conditions in plants

### **BOT-RE-6016 : Analytical Techniques in Plant Sciences**

CO1. Learn about principle of microscopy, flow cytometry, applications of fluorescence microscopy, chromosome banding, FISH, chromosome painting; transmission and scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching

CO2. Knowledge on different types of centrifugation, marker enzymes

CO3. Learn about use of Radioisotopes in biological research, auto-radiography, pulse chase experiment

CO4. Learn about principle and application of spectrophotometer in biological research

CO5. Knowledge on different chromatographic techniques used in research

CO6. Learn about mass spectrometry, X-ray diffraction, X-ray crystallography, characterization of proteins and nucleic acids, electrophoresis

CO7. Understand various statistical methods of analysis, measures of central tendency: arithmetic mean, mode, median; measures of dispersion: Range, mean deviation, variation, standard deviation, chi-square test for goodness of fit

#### PRACTICAL

CO8. Understand the concept of blotting technique, DNA finger printing, DNA sequencing and PCR through photograph

CO9. Understand the concept of ELISA

CO10. Practical knowledge on TLC

- CO11. Practical knowledge on isolation of Chloroplasts by differential centrifugation
- CO12. Practical knowledge on column chromatography
- CO13. Practical knowledge on protein estimation through Lowry's method
- CO14. Practical knowledge on PAGE
- CO15. Practical knowledge on separation of DNA (marker) using AGE
- CO16. Practical knowledge on different microscopic techniques using photographs/micrographs

### **BOT-RE-6026 : Dissertation**

- CO1. Practical knowledge on addressing relevant scientific questions through experimentation

## **Skill Enhancement Papers**

### **BOT-SE-3014 : Biofertilizers**

- CO1. Basic knowledge on the microbes used as biofertilizer, and understanding the process of their isolation, identification, mass multiplication, carrier based inoculants and knowledge on Actinorrhizal symbiosis
- CO2. Concept on the general characteristics, isolation, mass multiplication carrier based inoculants of *Azospirillum* and *Azotobacter* also the knowledge on the crop response to *Azotobacter*
- CO3. Basic knowledge on Cyanobacteria including factors affecting growth of Cyanobacteria, concept on the nitrogen fixation and use of blue green algae in rice cultivation
- CO4. Brief knowledge on the Mycorrhizal association and understand the details of various types, taxonomy, occurrence, distribution and growth parameters of Mycorrhiza
- CO5. Details about the organic farming, maintenance and recycling of biodegradable waste material and understand the methods of making biocompost and vermicompost with application

### **BOT-SE-3024 : Herbal Technology**

- CO1. Concept on the plants used as traditional medicine, and understanding the process of cultivation, harvesting, processing, storage, marketing and utilization of medicinal plants
- CO2. Brief knowledge on medicinal drugs obtained from plants and comprehensive idea about systematic position, medicinal uses of Tulsi, Ginger, Fenu greek, Indian goose berry and Ashoka
- CO3. Concept on the phytochemistry of medicinal herbs and identification, utilization of medicinal plants
- CO4. Basic knowledge on quality control, owing the medicinal properties of herbal drugs including the secondary metabolites and concept of drug adulteration, types, methods of drug evaluation
- CO5. Understand the process of micro propagation of important medicinal plant species.

### **BOT-SE-4014 : Nursery and Gardening**

- CO1. Brief idea about objectives, scope, infrastructure and maintenance of Nursery
- CO2. Concept on structure, types and dormancy of seeds and brief idea about seed storage including types and process and knowledge on seed production technology
- CO3. Knowledge on various modes of vegetative propagation and maintenance of plants in green house
- CO4. Brief idea about development and maintenance of gardening including scope and types and understand the various gardening operations including management of pests and diseases
- CO5. Detail knowledge on managements of seeds and seedlings and concept about cultivation, storage and

marketing of important vegetables

### **BOT-SE-4024 : Floriculture**

CO1. Basic knowledge including history, importance and scope of floriculture

CO2. Brief idea about Nursery management and garden operations and knowledge on the terms related to gardening and concept about role of plant growth regulators

CO3. Covers the knowledge of various ornamental plants and concept of cultivations of plants in pots and knowledge about Bonsai

CO4. Idea about various garden designs and features of such gardens and knowledge about some famous gardens of India

CO5. Knowledge about the process of making garden more attractive by altering the existing design in places of public importance, highways and educational institute

### **BOT-SE-4034 : Intellectual Property Right**

CO1. Knowledge on IPR, their types and infringement

CO2. Understanding about traditional knowledge and their protection, bio-prospecting and bio-piracy.

CO3. Knowledge on protection of plant varieties, farmer rights

CO4. Knowledge on Information technology related IPR; data, database, chips and domain name protection

CO5. Knowledge on novelty, bio-based patenting, and moral issues associated with biotechnological inventions

### **BOT-SE-5014 : Medicinal Botany**

CO1. Knowledge on medicinal plants and indigenous medicinal sciences/systems of India

CO2. Understanding about the endangered and endemic medicinal plants, conservation issues and types

CO3. Knowledge on ethno-medicinal gardens, nursery and its classifications and components

CO4. Understanding ethno-botany, folk medicines and ethnic communities; Knowledge on applications of ethno-medicine/natural products for treatment of jaundice, cardiac, infertility, diabetics, blood pressure and skin diseases

### **BOT-SE-5024 : Plant Diversity and Human Welfare**

CO1. Understanding diversity of plants at genetic, species and ecosystems level, Knowledge on agrobiodiversity, cultivated and wild taxa, importance of plants and microbes and their uses

CO2. Understanding importance of biodiversity, their loss and management/conservation strategies and types of conservation, Knowledge on various associations/organizations associated with biodiversity conservations

CO3. Understanding sustainable developments, Knowledge on importance of plants in human welfare

### **BOT-SE-6014 : Ethnobotany**

CO1. Understanding the concept of ethno-botany and its relation to other branches of science, Knowledge on ethnic/tribal groups of India, their life styles and plants used by them for various purposes and their role in conservation of medicinal plants

CO2. Knowledge on methodologies of ethno-botanical studies, importance of ethno-botany in modern medicine and to protect the interest of ethnic groups

### **BOT-SE-6024 : Mushroom Culture Techniques**

- CO1. Understanding concept of mushroom culture technology, Knowledge on edible and poisonous mushrooms, medicinal values of mushrooms and types of edible mushrooms
- CO2. Understanding the cultivation techniques of mushrooms and factors associated with their cultivations, Knowledge on low cost technology for mushroom production
- CO3. Knowledge on storage and nutraceutical values of mushrooms, Understanding on food preparations and marketing of mushrooms