



**WEST BENGAL STATE UNIVERSITY**

**DRAFT SYLLABUS UNDER CHOICE BASED  
CREDIT (CBCS) SYSTEM**

**B.Sc. with Botany**

## C

Details of Courses Under Undergraduate Programme (B.Sc.)

Course	*Credits	
	Theory+ Practical	Theory+Tutorials
<b><u>I. Core Course</u></b> (12 Papers) 04 Courses from each of the 03 disciplines of choice	12X4= 48	12X5=60
<b>Core Course Practical / Tutorial*</b> (12 Practical/ Tutorials*) 04 Courses from each of the 03 Disciplines of choice	12X2=24	12X1=12
<b><u>II. Elective Course</u></b> (6 Papers)  Two papers from each discipline of choice including paper of interdisciplinary nature.	6x4=24	6X5=30
<b>Elective Course Practical / Tutorials*</b> (6 Practical / Tutorials*) Two Papers from each discipline of choice including paper of interdisciplinary nature • Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6 <sup>th</sup> Semester	6 X 2=12	6X1=6
<b><u>III. Ability Enhancement Courses</u></b>		
1. Ability Enhancement Compulsory Courses (AECC) (2 Papers of 2 credits each) Environmental Science English/MIL Communication	2 X 2=4	2X2=4
2. Skill Enhancement Courses (SEC)	4 X 2=8	4 X 2=8

**Distribution of the courses in different semesters for Undergraduate course in Sciences**

<b>Semester</b>	<b>Core</b>	<b>DSE</b>	<b>GE</b>	<b>AECC</b>	<b>SEC</b>	<b>Total credit</b>
I	DSC 1A DSC 2A DSC 3A			Environmental Science		20
II	DSC 1B DSC 2B DSC 3B			English/MIL Communication		20
III	DSC 1C DSC 2C DSC 3C				SEC1	20
IV	DSC 1D DSC 2D DSC 3D				SEC2	20
V		DSE1A DSE2A DSC3A			SEC3	20
VI		DSE1B DSE2B DSC3B			SEC4	20
<b>Total number of courses</b>	12	6	0	2	4	120

**\*wherever there is practical there will be no tutorials and vice -versa**

# **B.Sc. with Botany**

---

## **Details of Courses offered**

### **Core Courses –Botany**

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

### **Discipline Specific Electives-Botany (Any two)**

1. Cell and Molecular Biology
2. Analytical Techniques in Plant Sciences
3. Bioinformatics

### **Ability Enhancement Compulsory Courses**

1. Environmental Science
2. English/MIL Communication

### **Skill Enhancement Courses (Any four)**

#### **Botany**

1. Biofertilizers
2. Medicinal Botany
3. Ethnobotany
4. Mushroom Culture Technology

## Core Courses

---

### Semester I

---

**Core Course: Botany Paper I**  
**Biodiversity (Microbes, Algae, Fungi and Archegoniate)**  
(Credits: Theory-4, Practicals-2)  
**THEORY**

**Lectures: 60**

#### **Unit 1: Microbes**

**(10 Lectures)**

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

#### **Unit 2: Algae**

**(12 Lectures)**

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

#### **Unit 3: Fungi**

**(12 Lectures)**

Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification (Hawksworth et al 1995); True Fungi-General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *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 (Proskauer 1954 up to class), Range of thallus organization. Systematic position, morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

## Unit 6: Pteridophytes

(8 Lectures)

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

## Unit 7: Gymnosperms

(6 Lectures)

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

### Practical

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

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

### Suggested Readings

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

Pvt. Ltd., Delhi.

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



---

## Semester II

---

### Core Course Botany –Paper II Plant Ecology and Taxonomy

(Credits: Theory-4, Practicals-2)

#### THEORY

Lectures: 60

#### Unit 1: Introduction

(2 Lectures)

#### Unit 2: Ecological factors

(10 Lectures)

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

#### Unit 3: Plant communities

(6 Lectures)

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

#### Unit 4: Ecosystem

(8 Lectures)

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

#### Unit 5: Phytogeography

(4 Lectures)

Principle biogeographical zones; Endemism.

#### Unit 6 Introduction to plant taxonomy

(2 Lectures)

Identification, Classification, Nomenclature.

#### Unit 7 Identification

(4 Lectures)

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

#### Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular

**data.** (6 Lectures)

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

Ranks, categories and taxonomic groups.

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

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

**Unit 11 Classification** (6 Lectures)

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

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

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

**Practical**

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

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

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

### **Suggested Readings**

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

---

## Semester III

---

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

Lectures: 60

**Unit 1: Meristematic and permanent tissues** (8 Lectures)

Root and shoot apical meristems; Simple and complex tissues.

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

Structure of dicot and monocot root stem and leaf.

**Unit 3: Secondary Growth** (8 Lectures)

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

---

**Unit 4: Adaptive and protective systems** (8 Lectures)

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

**Unit 5: Structural organization of flower** (8 Lectures)

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

**Unit 6: Pollination and fertilization** (8 Lectures)

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

**Unit 7: Embryo and endosperm** (8 Lectures)

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

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

Definition, types and practical applications.

### **Practical**

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

### **Suggested Readings**

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

---

## Semester IV

---

### Core Course Botany –Paper IV Plant Physiology and Metabolism (Credits: Theory-4, Practicals-2)

#### THEORY

Lectures: 60

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

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

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

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

**Unit 3: Translocation in phloem** (6 Lectures)

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

**Unit 4: Photosynthesis** (12 Lectures)

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; 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.

**Practical**

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

**Demonstration experiments (any four)**

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

**Suggested Readings**

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

**Discipline Centric Elective Courses**  
**Two (2) be selected from each of the three disciplines**

**Discipline Centric Elective Botany**

**Cell and Molecular Biology**  
**(Credits: Theory-4, Practicals-2)**

**THEORY**  
**Lectures: 60**

**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.



## 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. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
7. Study of mitosis and meiosis (temporary mounts and permanent slides).
8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
13. Study DNA packaging by micrographs.
14. 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.

## Discipline Specific Elective Botany Analytical Techniques in Plant Sciences (Credits: Theory-4, Practicals-2) THEORY Lectures: 60

### 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**

Use in biological research, auto-radiography, pulse chase experiment. **(4 Lectures)**

### **Unit 4: Spectrophotometry**

Principle and its application in biological research. **(4 Lectures)**

### **Unit 5: Chromatography**

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion exchange chromatography; Molecular sieve chromatography; Affinity chromatography. **(8 Lectures)**

### **Unit 6: Characterization of proteins and nucleic acids**

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE **(6 Lectures)**

### **Unit 7: Biostatistics**

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. **(15 Lectures)**

### **Practicals**

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separate DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. 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. 3<sup>rd</sup> 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. 3<sup>rd</sup> edition.
4. Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4<sup>th</sup> edition.

**Discipline Centric Elective Botany**  
**Bioinformatics**  
**(Credits: Theory-4, Practicals-2)**  
**THEORY**  
**Lectures: 60**

**Unit 1: Introduction to Bioinformatics** (5 Lectures)  
Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

**Unit 2: Databases in Bioinformatics** (5 Lectures)  
Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

**Unit 3: Biological Sequence Databases** (25 Lectures)  
National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression 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. Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data, Retrieval in PIR. Swiss-Prot: Introduction and Salient Features.

**Unit 4: Sequence Alignments** (10 Lectures)  
Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

**Unit 5: Molecular Phylogeny** (8 Lectures)  
Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

**Unit 6: Applications of Bioinformatics** (7 Lectures)  
Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

**Practical**

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. 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.

## Skill Enhancement Courses

### Skill Enhancement Course

#### Biofertilizers

(Credits 2)

Lectures: 30

**Unit 1:** General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. **(4 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. **(8 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. **(4 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. **(8 Lectures)**

**Unit 5:** Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. **(6 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

### Skill Enhancement Course

#### Medicinal Botany

(Credits 2)

Lectures: 30

**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. **(10 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. **(10 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. **(10 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, 2<sup>nd</sup> edn. Agrobios, India.

## **Skill Enhancement Course Ethnobotany (Credits 2) Lectures: 30**

### **Unit 1: Ethnobotany**

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. **(6 Lectures)**

### **Unit 2: Methodology of Ethnobotanical studies**

a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places. **(6 Lectures)**

### **Unit 3: Role of ethnobotany in modern Medicine**

Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology) a) *Azadiractha 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). **(10 Lectures)**

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

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. **(8 Lectures)**

### 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) Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd.

## Skill Enhancement Course Mushroom Culture Technology (Credits 2) Lectures: 30

**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*. **(5 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. **(12 Lectures)**

**Unit 3:** Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins. **(8 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. **(5 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.

