

**CHOICE BASED CREDIT SYSTEM SYLLABUS AND
STRUCTURE
for
B. Sc. with Botany**



Department of Botany,
Nagaland University, Lumami-798627,
Nagaland, India

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

<u>Course</u>	Theory+ Practical	Theory + Tutorials	*Credits
Core Course (12 Papers) (4 Courses x 3 disciplines of choice)	12x4= 48*	12x5= 60*	
Core Course Practical / Tutorial (4 Courses x 3 Disciplines of choice= 12 Practical/ Tutorials*)	12x2= 24*		12x1= 12*
Elective Course 2 papers from 3 discipline of choice including paper of interdisciplinary nature (6 Papers)	6x4= 24*		6x5= 30*
Elective Course Practical / Tutorials* (6 Practical / Tutorials*) 2 papers from 3 discipline of choice including paper of interdisciplinary nature	6 x 2= 12*		6x1= 6*
Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester.			
<u>Ability Enhancement Courses</u>			
Ability Enhancement Compulsory (2 Papers of 2 credits each) Environmental Science English/MIL Communication	2 x 2= 4*		2x2= 4*
Skill Enhancement Course (4 Skill Based Papers of 2 credits each)	4 x 2= 8*		4 x 2= 8*
	Total credit= 120		Total credit= 120

Institutes should evolve a system/policy about ECA/
General Interest/Hobby/Sports/NCC/NSS/related courses on its own.
Wherever there is practical there will be no tutorials and vice-versa

COMPREHENSIVE CBCS FOR B. Sc. (BOTANY)

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

BOTANY SPECIFIC COURSE DETAILS FOR CBCS

SEMESTER	COURSE	COURSE NAME	CODE	CREDITS
I	Core course 1	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	BCC-101	4
	Core Course 2	Biodiversity (Microbes, Algae, Fungi and Archegoniate) Practical	BCC-102	2
II	Core course 3	Plant Ecology and Taxonomy	BCC-201	4
	Core course 4	Plant Ecology and Taxonomy Practical	BCC-202	2
III	Core course 5	Plant Anatomy and Embryology	BCC-301	4
	Core course 6	Plant Anatomy and Embryology Practical	BCC-302	2
	SEC-1	Any paper from Annexure 1	BSEC-301	2
IV	Core course 7	Plant Physiology and Metabolism	BCC-401	4
	Core course 8	Plant Physiology and Metabolism Practical	BCC-402	2
	SEC -2	Any paper from Annexure 1	BSEC-2	2
V	SEC -3	Any paper from Annexure 1	BSEC-3	2
	DSE-1	Any paper from Annexure 2	BSE-501	4
	DSE-2	Practicals of DSE 1	BSE-502	2
VI	SEC -4	Any paper from Annexure 1	BSEC-4	2
	DSE-3	Any paper from Annexure 2	BSE-601	4
	DSE-4	Practicals of DSE 1	BSE-602	2
Total Credits				44

ANNEXURE 1 Skill Enhancement Courses (Any 4)	ANNEXURE 2 Discipline Specific Electives (any 2)
<ol style="list-style-type: none"> 1. Biofertilizers 2. Herbal Technology 3. Nursery and Gardening 4. Floriculture 5. Medicinal Botany 6. Plant Diversity and Human Welfare 7. Ethnobotany 8. Mushroom Culture Technology 9. Intellectual Property Right 10. Plant Tissue Culture 	<ol style="list-style-type: none"> 1. Economic Botany and Biotechnology 2. Cell and Molecular Biology 3. Analytical Techniques in Plant Sciences 4. Bioinformatics 5. Research Methodology 6. Optional Dissertation or project work in place of one Discipline elective paper (6 credits) in 6th Semester.

CORE COURSE

SEMESTER I

Core Course: Botany Paper I

Code: BCC-101

BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE)

THEORY (4 Credits)

Total 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; life-cycles of the following: *Nostoc*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae

Unit 3: Fungi

(12 Lectures)

Introduction- General characteristics, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, life cycle of *Rhizopus*, *Alternaria*, *Puccinia*, *Agaricus*; 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 (upto 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 (upto family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stellar evolution.

Unit 7: Gymnosperms

(6 Lectures)

General characteristics, classification (upto family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Economic importance.

SEMESTER I

Core Course: Botany Paper 2

Code: BCC-102

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

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

Suggested Readings

1. Kumar, H.D. (1999). **Introductory Phycology**. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). **Microbiology: An Introduction**, Pearson Benjamin Cummings, U.S.A. 10th edition.
3. Sethi, I.K. and Walia, S.K. (2011). **Text book of Fungi & Their Allies**, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). **Introductory Mycology**, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). **Biology**. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). **Pteridophyta**, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). **Gymnosperms**. New Age International (P) Ltd Publishers, New Delhi, India. --- ---
8. Parihar, N.S. (1991). **An introduction to Embryophyta**. Vol. I. Bryophyta. Central Book Depot, Allahabad. --- ---

SEMESTER II

Core Course: Botany Paper 3

Code: BCC-201

PLANTECOLOGYANDTAXONOMY

THEORY (4 Credits)

Total Lectures: 60

Unit1:Introduction to plant ecology and plant taxonomy (2Lectures)

Unit2:Ecological factors (10Lectures)

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.

Unit3:Plant communities (6Lectures)

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

Unit4:Ecosystem (8Lectures)

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

Unit5:Phytogeography (4Lectures)

Principle biogeographical zones; Endemism

Unit6 Introduction to plant taxonomy (2Lectures)

Identification, Classification, Nomenclature.

Unit 7 Identification (4Lectures)

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. (6Lectures)

Unit 9 Taxonomic hierarchy (2Lectures)

Ranks, categories and taxonomic groups

Unit10 Botanical nomenclature (6Lectures)

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

Unit11 Classification (6Lectures)

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

Unit12 Biometrics, numerical taxonomy and cladistics (4Lectures)

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

SEMESTER II

Core Course: Botany Paper 4

Code: BCC-202

PLANTECOLOGYANDTAXONOMY

Practical (2 Credits)

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and luxmeter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
 - (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).
 - (b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants)
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
6. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae - *Brassica*, *Alyssum* / *Iberis*; Asteraceae - *Sonchus* / *Launaea*, *Vernonia* / *Ageratum*, *Eclipta* / *Tridax*; Solanaceae - *Solanum nigrum*, *Withania*; Lamiaceae - *Salvia*, *Ocimum*; Liliaceae - *Asphodelus* / *Lilium* / *Allium*.
7. 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 & IBHP vt. Ltd., New Delhi. 3rd edition

SEMESTER III

Core Course: Botany Paper 5

Code: BCC-301

PLANT ANATOMY AND EMBRYOLOGY

THEORY (4 Credits)

TOTAL LECTURES: 60

Unit1:Meristematicandpermanenttissues (8Lectures)

Rootandshootapicalmeristems;Simpleandcomplextissues.

Unit2:Organs (4Lectures)

Structureofdicotandmonocotrootstemandleaf.

Unit3:SecondaryGrowth (8Lectures)

Vascularcambium–
structureandfunction,seasonalactivity.Secondarygrowthinrootandstem,Wood(heartwoodand
apwood).

Unit4:Adaptiveandprotectivesystems (8Lectures)

Epidermis,cuticle,stomata;Generalaccountofadaptationsinxerophytesandhydrophytes.

Unit5:Structuralorganizationofflower (8Lectures)

Structureofantherandpollen;Structureandtypesofovules;Typesofembryosacs,organ
izationandultrastructureofmatureembryosac.

Unit6:Pollinationandfertilization (8Lectures)

Pollinationmechanismsandadaptations; Doublefertilization;Seed-
structureappendagesanddispersalmechanisms.

Unit7:Embryoandendosperm (8Lectures)

Endospermtypes,structureandfunctions;Dicotandmonocotembryo;Embryo-
endospermrelationship.

Unit8:Apomixisandpolyembryony (8Lectures)

Definition,typesandpracticalapplications.

SEMESTER III

Core Course: Botany Paper 6

Code: BCC-302

PLANT ANATOMY AND EMBRYOLOGY

Practical

1. Study of meristem through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zeamays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zeamays*; 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.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryosac Development (Permanent slides/ photographs).
10. Ultrastructure of mature egg apparatus cell through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photograph and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings

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

SEMESTER IV

Core Course: Botany Paper 7

Code: BCC-401

PLANT PHYSIOLOGY AND METABOLISM

THEORY (4 Credits)

TOTAL LECTURES: 60

Unit1:Plant-waterrelations (8Lectures)

Importanceofwater,waterpotentialanditscomponents;Transpirationanditssignificance;Factorsaffectingtranspiration;guttation.

Unit2:Mineralnutrition (8Lectures)

Essential elements, macro and micronutrients; Role ofessential elements; Transport of ions across cell membrane, active and passive transport

Unit3:Translocationinphloem (6 Lectures)

Compositionofphloemsap;Pressureflowmodel;Phloemloadingandunloading.

Unit4:Photosynthesis (12Lectures)

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Photosynthetic Pigments; Photosystem I and II, reactioncenter, Electron transport and mechanism of ATP synthesis; C₃, C₄ andCAMpathwaysofcarbonfixation;Photorespiration.

Unit5:Respiration (6Lectures)

Glycolysis,TCACycle;Oxidativephosphorylation,OxidativePentosePhosphatePathway.

Unit6:Enzymes (4Lectures)

Structureandproperties;Mechanismofenzymecatalysisandenzymeinhibition.

Unit7:Nitrogenmetabolism (4Lectures)

Biologicalnitrogenfixation;Nitrateandammoniaassimilation.

Unit8:Plantgrowthregulators (6Lectures)

Plant hormones and physiologicalrolesofauxins,gibberellins,cytokinins,ABA,ethylene.

Unit9:Plantresponsetolightandtemperature (6Lectures)
Photoperiodism(SDP,LDP,Dayneutralplants); Outlines on Phytochrome andVernalization.

SEMESTER IV

Core Course: Botany Paper 8

Code: BCC-402

PLANT PHYSIOLOGY AND METABOLISM

Practical

1. Determination of osmotic potential of plant cells 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 mesophyte and xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxin 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.

Discipline Specific Elective Courses

Discipline Specific Elective
Economic Botany and Biotechnology

Course: Code DSE-1
TOTAL CREDITS: 4

THEORY

TOTAL LECTURES: 60

- 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** (6 Lectures)
General account with special reference to Gram and soybean
- Unit 4: Spices** (6 Lectures)
General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses)
- Unit 5: Beverages** (4 Lectures)
Tea(morphology,processing,uses)
- Unit 6: Oils and Fats** (4 Lectures)
General description with special reference to groundnut
- Unit7:Fibre Yielding Plants** (4 Lectures)
General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)
- Unit 8: Introduction to biotechnology** (2 Lectures)
- Unit 9: Plant tissue culture** (8 Lectures)
Micropropagation; haploid production through androgenesis and gynogenesis; brief account of embryo 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; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immuno detection, Molecular diagnosis of human disease, Human gene Therapy.

Discipline Specific Elective

Economic Botany and Biotechnology

Course: Code DSE-1 (P)
Practical

TOTAL CREDITS: 2

1. Study of economically important plants: Wheat ,Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings

1. Kochhar,S.L.(2011).**Economic Botany in the Tropics**. MacMillan Publishers India Ltd., NewDelhi.4th edition.
2. Bhojwani,S.S.andRazdan,M.K.,(1996).**PlantTissueCulture:TheoryandPractice**.ElsevierScience Amsterdam.TheNetherlands.
3. Glick,B.R.,Pasternak,J.J.(2003).**MolecularBiotechnology-PrinciplesandApplicationsofrecombinantDNA**.ASMPress,Washington.

Discipline Specific Elective Cell and Molecular Biology

Course: Code DSE-2 THEORY

TOTAL CREDITS: 4

TOTAL LECTURES: 60

Unit1: Techniques in Biology (8Lectures)

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

Unit2: Cell as a unit of Life (2Lectures)

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

Unit3: Cell Organelles (20Lectures)

Mitochondria: Structure, marker enzymes, composition; Semiautonomous nature; 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 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).

Unit4:Cell Membrane and Cell Wall (6Lectures)

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

Unit5:Cell Cycle (6Lectures)

Overview of Cell cycle, Mitosis and Meiosis

Unit6:Genetic material (6Lectures)

DNA: Miescherto 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): semi-conservative, RNA priming, replication of linear, ds-DNA, replicating the 5' end of linear chromosome including replication enzymes.

Unit7:Transcription (Prokaryotes and Eukaryotes) (6Lectures)

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

Unit8:Regulation of gene expression (6Lectures)

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

**Discipline Specific Elective
Cell and Molecular Biology**

Course: Code DSE-2(P)

Practical

CREDIT: 2

1. To study prokaryotic cells(bacteria),viruses, eukaryotic cells with the help of light and electronmicrographs.
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 the effect of temperature,organic solvent on semipermeable membrane.
6. Demonstration of dialysis of starch and simple sugar.
7. Measure the cell size(either length or breadth/diameter) by micrometry.
8. Study of special chromosomes(polytene & lampbrush) either by slides or photographs.
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. DeRobertis, E. D. P. and DeRobertis, 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
Analytical Techniques in Plant Sciences

Course: Code DSE-3THEORY

TOTAL CREDITS: 4

TOTAL LECTURES: 60

Unit1: Imaging and related techniques (15 Lectures)

Principles of microscopy; Light microscopy; Fluorescence microscopy; Applications of fluorescence microscopy: Chromosome banding, FISH, electron microscopy, cryofixation, shadow casting, freeze fracture.

Unit2: Cell fractionation (8 Lectures)

Centrifugation: Differential and density gradient centrifugation, CsCl₂ gradient, marker enzymes.

Unit3: Radioisotopes

Use in biological research, auto-radiography (4 Lectures)

Unit4: Spectrophotometry

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

Unit5: Chromatography

Principle; Paper chromatography; Column chromatography, Ion-exchange chromatography; Molecular sieve chromatography. (8 Lectures)

Unit6: Characterization of proteins and nucleic acids

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis (6 Lectures)

Unit7: Biostatistics

(15 Lectures)
Statistics, data, population; 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.

Discipline Specific Elective
Analytical Techniques in Plant Sciences

Course: Code DSE-3

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. 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

Discipline Specific Elective

Research Methodology

Course: Code DSE-3THEORY
TOTAL CREDITS: 4

TOTAL LECTURES: 60

Unit 1: Basic concepts of research (10 Lectures)

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: General laboratory practices (12 Lectures)

Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation of observations (6 Lectures)

Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue specimens and application of scale bars. The art of field photography.

Unit 4: Overview of Biological Problems (6 Lectures)

History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network.

Unit 5: Methods to study plant cell/tissue structure (6 Lectures)

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultra thin sections.

Unit 6: Plant micro techniques (12 Lectures)

Staining procedures, classification and chemistry of stains. Staining equipment .Reactive dyes and fluorochromes (including genetically engineered protein labeling with GFP and other tags).Cytogenetic techniques with squashed plant materials.

Unit 7: The art of scientific writing and its presentation (8 Lectures)

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright- academic misconduct/plagiarism.

Discipline Specific Elective Research Methodology

Course: Code DSE-3(P)

Practical

CREDIT: 2

1. Experiments based on chemical calculations.
2. Plant microtechnique experiments.
3. The art of imaging of samples through microphotography and field photography.
4. Poster presentation on defined topics.
5. Technical writing on topics assigned.

Suggested Readings

1. Dawson, C. (2002). **Practical research methods**. UBS Publishers, New Delhi.
2. Stapleton, P., Yondewei, A., Mukanyange, J., Houten, H. (1995). **Scientific writing for agricultural research scientists – a training reference manual**. West Africa Rice Development Association, HongKong.
3. Ruzin, S.E. (1999). **Plant microtechnique and microscopy**. Oxford University Press, New York, U.S.A.

Discipline Specific Elective BIOINFORMATICS

Course: Code DSE-4THEORY
TOTAL CREDITS: 4

TOTAL 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.

Discipline Specific Elective
BIOINFORMATICS

Course: Code DSE-4

PRACTICALS

TOTAL CREDITS: 2

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

Ghosh Z. and Bibekanand M. (2008) **Bioinformatics: Principles and Applications**. Oxford University Press.

Pevsner J. (2009) **Bioinformatics and Functional Genomics. II Edition**. Wiley- Blackwell.

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)

Total 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 bio- degradable 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** AktaPrakashan, Nadiad

Skill Enhancement Course
HERBAL TECHNOLOGY (Credits 2)

Total Lectures: 30

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. (6 Lectures)

Unit 2: Pharmacognosy - systematic position medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka. (6 Lectures)

Unit 3: Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; *Catharanthus roseus* (cardiotonic), *Withaniasomnifera* (drugs acting on nervous system), *Clerodendronphlomisoides* (anti-rheumatic) and *Centella asiatica* (memory booster). (6 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) (8 Lectures)

Unit 5: Medicinal plant banks micro propagation of important species (*Withaniasomnifera*, neem and tulsi- Herbal foods-future of pharmacognosy) (4 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 BookDistributors.
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 IBHpublishing 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. NiraliPrakashan.

Skill Enhancement Course
NURSERY AND GARDENING
(Credits 2)

Total Lectures: 30

Unit 1: Nursery, objectives and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants. **(4 Lectures)**

Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage, seed testing and certification. **(6 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 **(6Lectures)**

Unit 4: Gardening; objectives and scope - landscape and home gardening - parks and its components - plant materials and design - Gardening operations: soil laying, manuring, watering, management of pests and diseases.
(8 Lectures)

Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, onion, tomatoes, and carrots - Storage and marketing procedures.**(6 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.

Skill Enhancement Course
FLORICULTURE
(Credits 2)

Total Lectures: 30

Unit 1: Introduction: Importance and scope of floriculture and landscape gardening. **(2 Lectures)**

Unit 2: Nursery Management: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Wintering; Mulching; Topiary. **(8 Lectures)**

Unit 3: Ornamental Plants: Flowering annuals; Herbaceous perennials; Shade and ornamental trees; Ornamental foliage plants; Cacti and succulents; Bonsai. **(4 Lectures)**

Unit 4: Principles of Garden Designs: English, Mughal and Japanese gardens; Features of a garden, Water garden. Some Famous gardens of India. **(4 Lectures)**

Unit 5: Landscaping Places of Public Importance: Landscaping highways and Educational institutions. **(4 Lectures)**

Unit 6: Commercial Floriculture; Production and packaging of cut flowers; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Chrysanthemum, Rose, Lilium, Orchids). **(6 Lectures)**

Unit 7: Diseases and Pests of Ornamental Plants. **(2 Lectures)**

Suggested Readings

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

Skill Enhancement Course
MEDICINAL BOTANY
(Credits 2)

Total 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, tumor 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 PC, 2006. **Medicinal Plants: Ethnobotanical Approach**, Agrobios, India.
2. Purohit and Vyas, 2008. **Medicinal Plant Cultivation: A Scientific Approach**, 2nd edn. Agrobios, India.

Skill Enhancement Course
PLANT DIVERSITY AND HUMAN WELFARE
(Credits 2)

Total lectures: 30

Unit 1: Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Uses of plants, Uses of microbes. **(8 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. **(8 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. **(8 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. **(6 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

Skill Enhancement Course
ETHNOBOTANY

(Credits 2)

Total Lectures:30

Unit1: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 lifestyles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses. **(6Lectures)**

Unit2:MethodologyofEthnobotanicalstudies

a) Fieldwork b) Herbarium c) Ancient Literature d) temples and sacred places. **(6Lectures)**

Unit3:RoleofethnobotanyinmodernMedicine

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 *Rauwolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*.

Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management). **(10Lectures)**

Unit4:Ethnobotanyandlegalaspects

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.

(8Lectures)

Suggested Readings

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

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 - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus. (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, pickels, papads), drying, storage in saltsolutions. 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. (5Lectures)

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.

Skill Enhancement Course
Intellectual Property Rights
(Credits2)

Lectures:30

- Unit1:Introductionto intellectual property right (IPR) (2lectures)**
Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO
- Unit2:Patents (3Lectures)**
Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.
- Unit3:Copyrights (3Lectures)**
Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.
- Unit4:Trademarks (3Lectures)**
Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name.
- Unit5:Geographical Indications (3Lectures)**
Objectives, Justification, International Position, Multilateral Treaties, National Level, IndianPosition.
- Unit6:Protection of Traditional Knowledge (4Lectures)**
Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting 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.
- Unit7:Industrial Designs (2Lectures)**
Objectives, Rights, Assignments, Infringements, Defences of Design Infringement
- Unit8:Protection of Plant Varieties (2Lectures)**
Plant Varieties Protection-Objectives, 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.
- Unit9:Information Technology Related Intellectual Property Rights (4Lectures)**
Computer Software and Intellectual Property, Data base and Data Protection
- Unit10:Biotechnology and Intellectual PropertyRights. (4Lectures)**
Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting

Suggested Readings

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

Skill Enhancement Course
Plant Tissue Culture
(Credits2)

(i) Course Structure:

Sl. No.	Course	Title	Total number of hours
1.	PTC-1	Plant Tissue Culture: Techniques	10 hrs
2.	PTC-1.1	Practical course based on PTC-1	20 hrs
Total Number of contact hours			30 hours

Theory :

Plant Tissue Culture Techniques

1. Introduction, Scope. Advantages. Applications. Limitations.
2. Guidelines for establishing academic and commercial laboratory.
3. Steps involved in Plant Tissue Culture.
4. Various nutrient medium composition.
5. Plant growth regulators and their role in nutrient media.
6. Types of organ cultures and their applications.
7. Pathways of regeneration.
8. In vitro approaches of commercially important plants for crop improvement
9. Micropropagation.
10. Organogenesis.
11. Low cost methods for micropropagation.

Practicals in Pant Tissue Culture:

1. Handling and Instrumentation of Plant Tissue Culture.
2. Glassware Washing & Sterilization Techniques.
3. Preparation of stock solutions and nutrient media.
4. Surface sterilization of Explants.
5. Seed cultures for the establishment of organ cultures.
6. Establishment of organ cultures for the induction of callus
7. Establishment of organ cultures for the induction of multiple shoots
8. Sub-culturing for Clonal propagation and mass multiplication
9. Primary hardeningof tissue culture plants for their acclimatization.
10. Hardening and field trial.

Suggested Reading:

1. **Plant Tissue Culture** by S.SBhojwani and M.K Razdan . Published by Elsevier
2. **Plant Tissue culture: An Introductory Text** By S.S Bhojwani , Published by Springer
3. **Plant tissue culture** by Kalyan Kumar De, Published by NCBA