M. Sc. II Syllabus (2009-2010)
THIRD SEMESTER
BO. 3.1. Developmental Botany and Tissue Culture
BO. 3.2. Environmental Botany and Plant Diversity
BO. 3.31- 3.37 Special Paper
BO. 3.31. Phycology  I
BO. 3.32. Mycology and Plant Pathology  I
BO. 3.33. Angiosperms  I
BO. 3.34. Plant Physiology  I
BO. 3.35. Genetics, Molecular Biology and Plant Breeding  I
BO. 3.36. Plant Biotechnology I
BO. 3.37. Plant Diversity - I
BO. 3.4 Practicals based on Development Botany (BO. 3.1) and Environmental Botany and Plant Diversity (BO.3.2)
BO. 3.5 Practicals based on special paper I (BO. 3.31 to 3.37)

FOURTH SEMESTER
BO. 3.1. Plant Resource and Evolution
BO. 4.2. Applied Botany
BO. 4.41- 4.47 Special Paper
BO. 4.41. Phycology  II
BO. 4.42. Mycology and Plant Pathology  II
BO. 4.43. Angiosperms  II
BO. 4.44. Plant Physiology  II
BO. 4.45. Genetics, Molecular Biology and Plant Breeding  II
BO. 4.46. Plant Biotechnology II
BO. 4.47. Plant Diversity - II
BO. 4.4 Practicals based on Resources (BO. 4.1) and Environmental Botany and Plant Diversity (BO.3.2)
BO. 4.5 Practicals based on special paper II (BO. 4.41 to 4.47)

Three word files
1) 3SemTheroyFinal- containing theory and practical courses
2) 4SemTheoryFinal - Only theory courses
3) 4SemPractFinal- only practical courses
M. Sc. –II Botany Syllabus
(To be implemented from 2009-2010)

THIRD SEMESTER

BO. 3.1. Developmental Botany and Tissue Culture
BO. 3.2. Environmental Botany and Plant Diversity

BO. 3.31- 3.37 Special Paper

BO. 3.31. Phycology – I
BO. 3.32. Mycology and Plant Pathology – I
BO. 3.33. Angiosperms – I
BO. 3.34. Plant Physiology – I
BO. 3.35. Genetics, Molecular Biology and Plant Breeding – I
BO. 3.36. Plant Biotechnology – I
BO. 3.37. Plant Diversity - I

BO. 3.4 Practicals based on Development Botany (BO. 3.1) and Environmental Botany and Plant Diversity (BO.3.2)

BO. 3.5 Practicals based on special paper –I (BO. 3.31 to 3.37)

FOURTH SEMESTER

BO. 3.1. Plant Resource and Evolution
BO. 4.2. Applied Botany

BO. 4.41- 4.47 Special Paper

BO. 4.41. Phycology – II
BO. 4.42. Mycology and Plant Pathology – II
BO. 4.43. Angiosperms – II
BO. 4.44. Plant Physiology – II
BO. 4.45. Genetics, Molecular Biology and Plant Breeding – II
BO. 4.46. Plant Biotechnology – II
BO. 4.47.  Plant Diversity - II
BO. 4.4  Practicals based on Resources (BO. 4.1) and Environmental Botany and Plant Diversity (BO.3.2)
BO. 4.5  Practicals based on special paper –II (BO. 4.41 to 4.47)
BO 3.1 DEVELOPMENTAL BOTANY AND PLANT TISSUE CULTURE
(48 Lectures)

1. Plant development – concept, definitions and unique features (2L)
2. Processes basic to plant development (6L)
   a) Cell growth, division and differentiation
   b) Competence, determination, commitment specification, differentiation, dedifferentiation and dedifferentiation
   c) Polarity and symmetry
   d) Integration and organization of cells into tissues, tissues into organs, and organs into whole plants.
   e) Cell-cell interaction
   f) Programmed cell death
   g) Factors controlling plant development – intrinsic and extrinsic
   h) Vegetative development – structure and organization of seed embryo.
   i) Embryonal axis- meristems
   j) Seed germination – establishment of seedling organ
   k) Meristems as dynamic centers of cell generation.
   l) Organ development – primordium to organ
   m) Juvenility – characteristics, transition to adult phase
   n) Coordinated development
3. Transition – Vegetative to reproductive phase (2L)
   Transition from vegetative phase – morpho – histo- cytochemical changes in vegetative plant body
4. Male and female gametophyte development (3L)
   a) Development of stamen, anther, sporogenous tissue, microspores, male germ unit.
   b) Development of carpel, ovule, sporogenous tissue, megaspore- female gametophyte – female germ unit.
5. Fertilization (3L)

c) Maturation of seed

d) Developmental routes to parthenogenesis, parthenocarpy, appomyxis.

e) Androgenesis and gynogenesis

6. **Physiology of development** (3L)
   a) Light mediated regulation of vegetative and reproductive development
   b) Hormonal control of vegetative and reproductive development.
   c) Transduction of light and hormone signal during growth and development.
   d) Cell lineages, cell fate mapping, positional informational technique for studying development, specific gene expression,

7. **Molecular basis of development** (4L)
   a) Embryogenesis and seedling development.
   b) Root shoot and leaf development.
   c) Gene expression during transition to flowering and flower development.
   d) Molecular genetics of gametophytes development and expression of self incompatibility.

8. Developmental botany and its applications. (1L)

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**Plant Tissue Culture- 24 Lectures**

1. Plant Tissue Culture – Introduction, Scope, Objectives History (1L)
2. Totipotency, pleuripotency, cytodifferentiation. (1L)
3. Nutritional requirements of the explants in PTC, role of PGRs and additives (1L)
4. Micropropagation – Stages and pathways (1L)
5. Organogenesis and Embryogenesis – Direct and indirect, zygotic and somatic (2L)
6. Study of different culture systems with respect to introduction, types, protocol, factors affecting and applications – callus, single cell, suspension, apical meristem, shoot tip, axillary bud, leaf, nodal sectors, root tip, anther, pollen, ovary, ovule, embryo, endosperm, seed. (4L)
7. Protoplast Culture & Somatic hybridization - Isolation, culture, fusion, selection.
8. Somaclonal variation – introduction, types, causes, selection methods, (2L)
9. Applications – Micropropagation, production of disease/virus free plants, production of useful mutants/somaclonal variants, production of haploids and triploids, synthetic seeds, embryo rescue, production of secondary metabolites, germplasm conservation (Short term & long term storage, cryopreservation) (5L)
10. Advantages of tissue culture technique over conventional methods of crop improvement, transgenic plants/GM crops. Applications of PTC in Agriculture, Horticulture, Floriculture, Forestry, Medicinal and Aromatic plants etc. (4L)
1. **Environmental Science**: Interdisciplinary science, Scope and necessity, Concept of biosphere, Recent approaches in the study of environmental science, Modern tools in the study of environmental science – GIS, GPS, RS Data, Aerial photography, and its data interpretations


3. **Phytogeography**: Phytogeographic regions of India, basis of classification, account of each region, floristic realms, speciation, endemism, life ones, Red data book, IUCN categories, CBD- Convention on Biological Diversity, CITES etc.


5. **Community Ecology**: Forms and structure of communities, Guild, Physiognomy, classification of communities, functional aspects of communities- seasonal, periodism, phototropism and metabolism

6. **Pollution**: Types air, water, soil and noise.
   a) **Air pollution**: Primary & secondary air pollutants, their impact on plants, Acid rain – process and its impact on aquatic and terrestrial ecosystem. Acid rain - its causal factor and ecological impact on the terrestrial and aquatic ecosystems.
   b) **Water pollution**: Types and sources. Eutrophication- natural and man made. Impact on the water quality and flora algal blooms and aquatic weeds, control measures of eutrophication.
   c) **Soil pollution**: sources and types of soil pollutants and its impact on soil quality
d) **Heavy metal pollution**: Nature of heavy metals, Ecological effect of heavy metals. Ionizing radiation and radioisotopes, pesticides, (2L)

e) **Global Climate Change**: Green house gasses and effect possible effect of global warming: Weather and climate. Kyoto Protocols, Carbon sink, CDM, Carbon regenestration, carbon trade. (2L)

7. **Environmental legislation in India**: Environmental (Protection) act, Indian Biodiversity act, Air and water pollution acts, Forest acts, etc. (2L)

8. **EIA**: Concept, scope, process and necessity with case studies such as Thermal, Irrigation project, mining etc. EMP. (2L)

**PLANT DIVERSITY (16 lectures)**

9. **Biodiversity**: Concept and definitions, Types of Biodiversity:
   a) **Genetic diversity** – Introduction, nature and origin of genetic variations and measurement such as based on DNA and Chromosome, Molecular marker etc. (1L)
   b) **Species diversity**: Species inventory, origin of species diversities, diversity indices, species richness and abundance alpha and Beta diversity. (1L)
   c) **Ecosystem diversity**: Classification of ecosystems, major ecosystems of the world. (2L)
   d) Methods of measuring biodiversity (2L)

10. **Loss of biodiversity**: Factors affecting diversity, natural verses anthropogenic., present and past rate of loss of biodiversity and its consequences on the human life. (3L)

11. **Value and use of biodiversity**: Ethical, asthetic, food, fodder, ornamentals, medicinal, economical and socioecological approach etc. (2L)

12. **Conservation and Management**: Conservation, CBD, CITIES, Ramsar, Indian Biodiversity Act. (1L)


**References Books**

2) K. V. Krishnamurthy, An advanced Text book on Biodiversity, Principles and practices –
oxford IBH, New Delhi.
3) Begon and Harper 1986, Population ecology
4) Kormondy 1996, Concept of ecology
5) Kumar H.D. Concept of ecology
   University Press, Cambridge, U. K.
   University Press, Cambridge, U. K.
11) Das. Concept of ecology

2. Systematics of blue green and green algae (order, families, generic level) (12L)

3. Systematics of brown and red algae (order, families, generic level) (12L)


References
1) Charles D. Amsler *Algal Chemical Ecology*


3) Fritsch, F. E. *Structure and Reproduction of the Algae -*


5) Kathleen M. Cole, Robert G. Sheath – 1990 *Biology of the red algae*


8) Peter Robert Bell, Alan R. Hemsley *Green plants: their origin and diversity*


10) Robert Arthur Andersen (2005), *Algal culturing techniques*

11) Robert Edward Lee (2008), *Phycology*


13) Yves Le Gal, Roland Ulber, Garabed Antranikian. *Marine Biotechnology*

BO-3.32 MYCOLOGY AND PLANT PATHOLOGY (SPECIAL PAPER I)  
(48 LECTURES)

1. **Introduction**- 
   History, systems of classification as per Bessey, Alexopoulos, Ainsworth, Webster, Alexopoulos, Mims & Blackwell  
   (3L)

   (24L)

3. **Heterothallism and phylogeny in fungi** –  
   a) Heterothallism in mucorales, oomycetes, basidiomycetes.  
   b) Algal and protozoan ancestry, Biochemical support for evolutionary relationships in fungi – Zygomycetes, Ascomycetes and Basidiomycetes.  
   (5 L)

4. **Fungal ecology** –  
   Colonization strategies, fungal habitats, fungal association with higher plants, algae and insects, rhizosphere, phylloplane, seed and air borne fungi, soil fungi.  
   (8L)

5. **Fungal Genetics** –  
   Fungi as tools of genetical studies, genetical aspects of pathogenicity and host resistance, virulence.  
   (4L)

6. **Fungal physiology** –  
   Fungal nutrition (Carbon, nitrogen & minerals), mycotoxins, sex hormones, fungal growth.  
   (4L)
1] ICBN
Review of code of Botanical nomenclature, Main divisions of ICBN – Principles, Rules and Recommendations, Definitions, Type concept and various types, Effective and valid publications, Citation of author(s), and Literature. Procedure for describing new genus and species. Floristic composition of India with special reference to biodiversity of angiosperms in world. Angiosperms diversity of Western Ghats.

2] Systematic as a synthetic subject
Systematic as a synthetic subject. Multidisciplinary approach to systematic of major groups / taxa of angiosperms (at least five case studies). For example Amentiferae, Centrospermae, Loranthaceae, Rannuculaceae, Santalaceae.

3] Biosystematics

4] A) Botanical Gardens
Gardens versus natural vegetation
Botanical Garden – Concept
Features distinguishing it from other garden types
Organization and units and facilities of a botanical garden
Objective and function of a botanical garden
Role of botanical gardens in
Systematics
Floristics
Teaching
Research
Public education
Conversion of Phytodiversity
Botanical gardens of the world (Any two)
Botanical gardens of India (Any two)
Botanical gardens as multipurpose resource Institutes.

4] B) **Herbaria**

Organization units and facilities of a typical Herbarium as an institute organization

Objective and function of a herbarium

Herbarium as a multipurpose resource institute

Role of herbarium in
   - Systematics
   - Floristics
   - Teaching
   - Research
   - Assessment and documentation of Phytodiversity
   - Public education

Major Herbaria of the world

Major Herbaria of India

Digitized Herbaria – advantage and limitations
   - Haritarium
1) **Stress Physiology** – Abiotic stress, Concept, Scope, Importance, Recent research at different centers in India and abroad. (2 L)

2) **Water stress** - Water deficit and Drought – Concept, yield, reduction, Physiological implications, Drought resistance mechanisms, Role of Proline, Glycine betaine, Polyols and stress induced proteins. Transgenics for drought stress tolerance. (6 L)

3) **Water logging** – Concept, Scope, Importance, Causes of water logging, water logging injury, Mechanism of flooding tolerance. (6 L)

4) **Salt Stress** – Concept, Scope, Importance, saline, saline-alkaline and sodic soils, causes and their improvement.
   - Effect of salt stress on plant metabolism.
   - Mechanism of salt tolerance in higher plants. (8 L)

5) **Ion stress** – Ion toxicity – Concept, Scope, Importance.
   - Toxicity of Al, Fe, Mn, Zn on plant metabolism.
   - Mechanism of tolerance. (6 L)

6) **Radiation stress** – Effect of UV-A and UV – B radiation on plant metabolism, photo-inhibition and mechanism of UV tolerance. (8 L)

7) **Oxygen toxicity** – Free radicals (ROS) generation and effect on plants. Scavenging of free radicals. (6 L)

8) **Xenobiotic (Pollution stress)** – Concept, Scope and Importance.
   - Effect of air pollutants on plant metabolism. (6 L)

**Reference books –**

3. Plant Physiology by R. G. S. Bidwell (revised edn.)
1. **Introduction** (4 L)
   Transmission genetics, Biochemical Genetics, Molecular Genetics and Population Genetics. Relationship of Genetics to other areas of Biology. Applied and applied research in genetics. Organisms suitable for genetic experimentation. Experimental approaches commonly used in genetic research today. Interaction of genes, Extranuclear inheritance, Quantitative inheritance, recombination and linkages.

2. **Chromosomes and Inheritance** (7 L)
   Morphology of chromosomes and chromosomal theory of inheritance. Morphological markers: Nuclear organizer, satellite, euchromatin and heterochromatin, centromere and telomere. Structural characteristics of Bacterial chromosomes, Bacterial chromosome, Phage chromosome (T-even, ΦX 174, λ, M13), Structural characteristics of eukaryotic chromosome. Cellular DNA content (C Value-Paradox) and the structural and organizational complexity of Chromosomes, nucleosome structure – Histones, histones tail and DNA, chromosome scaffold. Unique sequences and repetitive sequences of DNA in eukarotic Chromosomes, Special chromosomes- Polytene and lamprush. Artificial chromosomes- YAC and BAC, Accessory chromosomes.

3. **Karyotype** (2 L)
   Definition, importance. Evolution of Karyotype. All types of banding patterns and its application.
4. **Ploidy** (3 L)

Origin, production, meiosis in autopolyploids, chromosome segregation, Allopolyploids types, genome constitution and analysis, evolution of major crop plants (Cotton, Wheat, Tobacco, Mustard)

Haploids – Origin, production, meiotic behavior, detection, role in cytogenetics and plant breeding

Trisomics and Monosomics. Induction, characteristics, transmission, their role in chromosomes mapping in diploids and ployploids.

5. **Alien gene transfer** (2 L)

Alien gene transfer through chromosome manipulation with special reference to wheat transfer of whole genome, transfer of individual chromosome and chromosome segments, production, characterization and utility of alien addition and substitution lines.

6. **Mechanism of genetic recombination** (8 L)

Bacteria – transformation, conjugation, and transudation

Viruses – Fine structure of rII locus in T₄ phage.

Mechanism of genetic recombination in eukaryotes

Independent assortment and crossing over, role of recA, recACD enzymes

Site specific recombination

Chromosome mapping

Linkage groups, genetic markers,, constitution of molecular maps,
correlation of genetic and physical maps,

Somatic cell genetics –on alternative approach to gene mapping.

Homologous and non homologous recombination

Holiday Junction, Gene targeting , Gene disruption

FLP/FRT and Cre/Lox Recombination.

7. **Probability and statistical testing** (4 L)

Probability rates, calculations of genetic ratios, ratios of two or more segregating gene pairs, level of significance, degree of freedom, Chi-square method with more than one degree of freedom, Null hypothesis, test of independence, Homogeneity Chi-square, the Binomial expansion, testing hypothesis using Binomial distribution. Test of Significance (f,t,z)
PLANT BREEDING

8. General consideration of Plant breeding –
   Objectives of plant breeding, Germplasm and its types, Germplasm collection centers, Centers of origin of crop plants, Techniques of hybridization, breeding methods, varietals release and Seed multiplication mechanism, some important achievement of plant breeding.

9. Breeding methods for self pollinated crops -
   Applications, procedure, merits and demerits of mass selection, pure line selection, pedigree selection, bulk method and backcross methods.

10. Breeding methods for cross pollinated crops
    Population improvement through mass, progeny and recurrent selections, Development of inbreds, isolation of inbreds through inbreeding, Production of hybrid seed (single cross hybrid varieties) using cytoplasmic- genic male sterility and manual emasculation or pollination. Merits and demerits of hybrid varieties, achievements through hybrid varieties. Breeding in vegetatively propagated plants, clonal selection, somaclonal mutation.

11. Field evaluation techniques
    Design for yield and agronomic evaluations and their analysis. Completely randomized block, lattice and latin square designs and factorial experimental designs.

12. Mutation in Crop Improvement -
    Introduction
    Treatment methods, predictions concerning outcome of mutagenic treatments, starting material, individual and combined mutagenic agents Handling of treated material and their succeeding generations (M1,M2 and M3) and chimera development, Screening of Mutants (Chlorophyll, Morphological, Biochemical)

12. Correlations in plant breeding
    Introduction, simple correlation, partial, multiple, interpretation of correlations, and applications of crop improvement.
BO 3.36 PLANT BIOTECHNOLOGY SPECIAL PAPER I

1. **Plant Biotechnology** – overview, concept, definition history (2 L)

2. **Plant tissue culture**
   a) Objectives and goals of plant tissue culture, laboratory design and development, operation and management. Basic principles of invitro culture, factors influencing morphogenesis. Tissue culture media-handling, preparation, equipment, stock solution. (8 L)
   b) **Types of cultures** – Explants culture, callus formation and its culture, callus desiccation, organogenesis, meristem culture, axillary bud culture, protocol and schedule of observation, some clonal variation, selection. (8 L)
   c) Micro Propagation – Advantages of tissue culture technique over conventional methods of crop improvement, plant growth regulators/retardants in plant tissue culture, somatic embryogenesis cell suspension culture. (8 L)

3. **Transgenics** - For stress tolerance, secondary metabolites, crop improvement, somaclonal variation, somatic hybridization, haploids in plant breeding, increase in productivity by manipulation of photosynthesis, nitrogen fixation, nutrient uptake, efficiency, biotic and abiotic stress tolerance-insects, fungi, bacteria, viruses weeds, drought, salt, flooding, temperature, quality improvement of proteins, lipids, carbohydrates, plant bodies, Plant derived vaccines. (10 L)

4. **Green House technology** – conservation. Operation, maintenance, managements (4L)

5. **Cryopresovration** – importance, methods, future prospects. (4 L)

6. Phytoremediation, single cell proteins, bioferkizers – mycorrhiza, BGA - (4 L)
1. **Biodiversity: Definition and Scope** (3L)
   - Introduction, Overview of the topic and course
   - Biodiversity Concept and Definition,
   - Scope of Biodiversity
   - Levels of biodiversity: genetic, species, ecosystem, and landscape

2. **Evolution of Biodiversity:** (4L)
   - The History of Life on Earth, Earth’s Biodiversity – the Fossil Evidence; Major episodes in the evolution of life (its early evolution, the Cambrian explosion, mass extinctions) in the context of environmental change. Darwin Evidence for natural selection Micro and macroevolution
   - The origin of species, the species concept

3. **Magnitude and distribution of Biodiversity** (6L)
   - Current magnitude of plant diversity, An overview of the variety of life forms; Global distribution of biodiversity, factors affecting species distribution, number of species worldwide, estimates and examples of recently discovered communities, abundance of species in different ecosystems of the world; identification of diversity Hot-spots; Biodiversity of India Endemism and biodiversity

4. **Assessment and monitoring of biodiversity** (4L)
   - Methods of assessing and measuring biodiversity; Diversity indices; Comparison of different sampling techniques; techniques for monitoring plant, bird, insect, mammals, reptiles and fish biodiversity

5. **Genetic Diversity** (6L)
   - Introduction
   - Nature and Origin of Genetic Variations
   - Measurement of Genetic Diversity: Introduction, Methods based on DNA and Chromosomes
   - Molecular Marker Techniques: Allozyme method, DNA based Marker Techniques
   - Determinants of Genetic Diversity
   - Genetic Diversity vs Transgenic Organisms

6. **Species Diversity: Wild Taxa** (7L)
   - Introduction
   - Species Inventory: How good should an Inventory be?, Problems in Inventoraying Species,
   - Monitoring
   - Species Diversity
   - History and Origin of Species Diversity
   - Diversity Indices Based on Species: Species Richness, Species Abundance, Taxic Diversity
   - Comparison of Species Diversity of Different Sites: Species / Area Relationships
   - Spatial Patterns of Species Diversity, Global Distribution of Species Richness
   - Distribution of higher Plant Species Diversity, Centers of Diversity
7. **Agro-biodiversity and Cultivated Taxa**  
   Introduction  
   Origin and Evolution of Cultivated Species Diversity: Introduction, Act of Domestication, Geography and Domestication, Dispersal and Diversification  
   Diversity in Domesticated Species

8. **Ecosystem Diversity**  
   Introduction  
   Classification of Ecosystems  
   Measuring Ecosystem Diversity  
   Major Ecosystem Types of the World: Tropical Moist Forests, Temperate Forests, Arid and Semi-arid Ecosystems, Boreal Forests, Arctic and Alpine Systems, Grasslands  
   Wetland Ecosystems: Freshwater Wetlands, Marine Ecosystems  
   Agro-ecosystems  
   Urban and Peri-urban Diversity: Introduction, Nature of Urban Biodiversity, Species Diversity in Urban Habitats, and Importance of Urban Biodiversity  
   Plant Diversity Hotspots in India

9. **Diversity at Taxonomic level:**  
   With reference to number of species, habit, habitat, distribution and evolutionary success  
   Microbial diversity (Viruses and Bacteria)  
   Algal diversity  
   Fungal diversity  
   Lichen diversity  
   Bryophyte diversity  
   Pteridophyte diversity  
   Gymnosperm diversity  
   Angiosperms diversity

**Reference Books:**

6. Global Biodiversity Assessment (UNEP) by-Heywood V, (edt)  
10. This Fissured Land: An Ecological History of India (1992) Gadgil M. & Guha R.; Oxford University Press, New Delhi  
15. Forest Genetic Resources: Status, Threats and Conservation Strategies (2001), Uma Shaanker, R. Ganeshiah, KN. & Bawa KS (Eds); Oxford & IBH, New Delhi
Practicals based on Developmental Botany BO. 3.1

1. Isolation of shoot apical meristems from seedling, young and mature vegetative plant. (1P)
2. Tracing the course of stomatal development and observations on stomatal types. (1P)
3. Histological analysis of secondary growth (Primary or secondary axis) (1P)
4. Study on Microsporogenesis, megasporogenesis and male and female gametophyte developmental stages (1P)
5. Study of type of endosperm and developmental stages of embryogenesis (1P)
6. Dissection of haustorial endosperm (1P)
7. Dissection of seed and embryo of dicot and monocot (1P)
8. Histochemical analysis and comparison between vegetative SA and reproductively induced SA. (1P)

Practical: Plant tissue culture (8 Practical)

1. PTC – Laboratory organization, different sterilization/aseptic technique. (1P)
2. Preparation and sterilization of media (1P)
3. Callus culture (morphological and internal structure) and suspension cultures (growth curve) (1P)
4. Shoot tip, axillary bud, nodal explant culture. (1P)
5. Root tip and leaf culture. (1P)
6. Protoplast isolation and fusion (1P)
7. Somatic embryogenesis and production of artificial seeds. (1P)
8. Anther, pollen, ovule culture. (1P)
1) Quantification of phytoplankton: by using single drop method / Lackey’s drop method / Sedgewick/Rafter cells etc. (3P)

2) Demonstrations of: fluorescence microscopy, phase contrast microscopy, bright field / dark field microscopy and photomicroscopy (3P)

3) Cyanophyta (2P)

4) Chlorophyta & Charophyta (4P)

5) Phaeophyta (3P)

6) Rhodophyta (3P)

7) Limnological studies of water bodies wrt. physical chemical and biological analysis (2P)

8) Study of Fossil algae (1P)

9) Algal indices (2P)
1. Isolation of aquatic and soil fungi by baiting method  

2. Study of heterothallism.  

3. Isolation of soil fungi by soil dilution method.  

4. Isolation of phylloplane fungi by leaf impression method.  

5. Isolation of fungi from rhizosphere and non-rhizosphere soil.  


8. Isolation of plant pathogenic fungi from leaves, stem, fruits and soil  


10. Study of any forest and crop systems to identify and collection of fungi and submission of excursion report.  

11. Study of seed borne fungi and post harvest pathogens of any four fruits and vegetables each.
1] Classification and identification of at least 3 species of *Sida, Indigofera, Cassia, Solanum, Leucas, Alysicarpus, Euphorbia, Cyperus, Amaranthus, Chlorophytum, Commelina*, (3P)

2] Taxonomic distribution of special units of pollen dispersal, bicelled pollen, tetrads, polyads and pollinia and types. (1P)

3] Characterization of flower pigments of Caryophyllales, Ficoidales and Curvembryae. (1P)


5] Karyotype analysis of species of Allium OR Aloe OR Alysicarpus (1P)

6] Preparation of vegetation maps using aerial photographs and satellite imageries (1P)

7] Field visits- field observations documentation on field (field records) (1P)

8] Digitization of herbarium specimens (2P)

9] Inventrorization of a taxon folder (family) of departmental herbarium (2P)

10] Visit & reporting of a BSI herbarium (1P)

11] Visit & reporting of a botanical garden. (2P)
1. Effect of salt / drought on PEPcase activity. (2P)
2. Effect of salt / drought on Rubisco activity. (2P)
3. Estimation of proline under heavy metal stress. (2P)
4. Estimation of glycine betaine under salt stress. (2P)
5. Study of induced proteins by SDS – PAGE during drought stress. (2P)
6. Determination of Na⁺, K⁺, Ca²⁺ and EC of saline soils and salt stressed plants. (2P)
7. Determination of SOD activity under salt stress. (1P)
8. Determination of peroxidase activity under heavy metal stress. (2P)
9. Determination of RWC under salt / drought / heavy metal stress. (1P)
10. Determination of lipid peroxidation under salt / drought stress. (2P)
11. Determination of nitrate reductase activity under salt stress. (2P)
12. Analysis of deficiency symptoms of NPK. (2P)
13. Determination of CSI and MSI in plants under drought stress. (2P)
**BO 3.5 PRACTICAL BASED ON GENETICS, MOLECULAR BIOLOGY AND PLANT BREEDING SPECIAL PAPER 3.35**

1. Preparation of cytological stains & fixatives, preservation (1 P)
2. Study of external morphology of metaphase chromosome from suitable plant material employing aceto-orcein and fulgen stain. (1 P)
3. Determination of chromosome count from dividing root tip cells of Onion. (1 P)
4. Linear differentiation of chromosome through banding techniques such as G-banding/C-banding/Q-banding. (2 P)
5. Study of substages of prophase-I of meiosis in maize/onion/Tradescantia/Aloe and to calculate chisma frequency in Dikinesis. (3 P)
6. Emasculation and bagging of flowers of cereals and legumes and pollinating them manually. (1 P)
7. Induction of polyploidy in any suitable crop plants using colchicine. (1 P)
8. Induction of mutation employing chemical mutagen and study of morphological characters and variation from M1 generation and Identification of chlorophyll mutants following treatments with chemical mutagens. (3 P)
9. Identification of mutant phenotypes from any suitable material maintained by Department. (1 P)
10. Field exploration for detection of male sterile plants and estimation of their pollen sterility in locally grown crop plants (any five cereals or legumes) (1 P)
11. Detection of peroxidase and catalase isozyme markers from suitable plant material. (2 P)
12. Statistical Analysis- Chi Square Test, Correlation and ANOVA. (2 P)
13. Visit to Plant Breeding Research Center (1 P)
BO 3.5 PRACTICALS BASED ON SPECIAL PAPER PLANT BIOTECHNOLOGY PAPER- I
(BO 3.36)

1. Media preparation- (2 P)
2. Callus culture (2 P)
3. Organ genesis (2 P)
4. Cell suspension culture (2 P)
5. Technique of hardening (2 P)
6. Visit to commercial R and D green houses, agro-based industries and submission of detail report (2 P)
7. Preparation of biofertilizers (2 P)
8. Somatic embryo genesis (2 P)
9. Study of any four transgenics (2 P)
10. Anthoer and embryo culture (2 P)
11. Effect of plant growth regulators on various explants for callus induction cell suspension culture, growth, analysis, cell planting efficiency. (4 P)
12. Protoplast isolation and fusion (2 P)
BO 3.5 PRACTICALS BASED ON SPECIAL PAPER BO 3.37 SPECIAL PAPER- I
(Plant Biodiversity)

1. Plant Identification: General techniques; use of printed and interactive keys; practical identification work. (2P)
2. Methods for estimating above-ground biomass for carbon pool assessment (2P)
3. Methods for estimating below-ground biomass for carbon pool assessment (2P)
4. Chemotaxonomic analysis of any suitable genus (at least three species) (2P)
5. Ex situ conservation methods of biodiversity – micro-propagation (pollen/anther/embryo/tissue culture) of rare or endangered plant species (Demonstration) (1P)
6. Seed preservation methods (1P)
7. Protein electrophoresis of selected species. (2P)
8. Study of morphological and structural adaptations of locally available hydrophytes, mesophytes, xerophytes, halophytes and epiphytes and correlate to their particular habitats (Collection and identification of two species from each group is expected). (3P)
9. Map of the phytogeographical regions of India (1P)
10. Study of some endangered plant species. (1P)
11. Field trips to places for study and observation of vegetation types (including any one plant diversity hotspots/National Parks/Wildlife Sanctuary) prescribed in the syllabus for 2 to 5 days under the guidance of teachers. (3P)

(Submission of any five forms from Algae, Fungi, Lichens and Bryophytes, is compulsory. Preparation and submission of field visit report at the time of practical examination is must.)

12. Construction of quadrat - to study the percentage of frequency, density, abundance and their relative values of herbaceous community. Prepare their frequency class diagram and compare them with Raunkiaer’s Normal Frequency Diagram and also find out the Simpson’s Index of Dominance. (4P)
BO 4.1 PLANT RESOURCES AND EVOLUTION

(48 Lectures)

Plant Resources (24L)
1. Domestication and introduction of plants; origin of cultivated plants; Vavilov’s centers of origin (2L)
2. Plants as source of food, fodder, fiber, spices, beverages, edible oils, narcotics, insecticides, timber, gums, resins and dyes, latex, cellulose, starch and its products; Perfumery. (4L)
3. Importance of Ethnobotany in Indian context; Energy plantations; Botanical Gardens and Herbaria. (4L)
4. Plants in medicine – types of secondary metabolites, pharmacological activities of natural products (2L)
5. Phytochemical investigations of primary and secondary metabolites – quantitative and qualitative analysis of carbohydrates, proteins, lipids. Phytochemical analysis by advance (chromatographic, spectroscopic) techniques (4L)
6. Forensic Botany – Role of morphology, anatomy and chemotaxonomy in criminology (2L)
7. Methods of standardization of crude drugs and adulteration - Organoleptic, microscopic and physical evaluation (2L)
8. Monograph of drugs wrt. Botanical source, geographical distribution, cultivation, collection, drying, preparations, preservation, chemical constituent, therapeutic uses from different parts of plant – root, rhizome, stem, bark, leaf, flower, fruit, seed. (4L)

Evolution (24 Lectures)
9. Emergence of evolutionary thought: Lamarck; Darwin – concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; the evolutionary synthesis. (4L)
10. Origin of cells and unicellular evolution: Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concepts of Opairn and Halden; experiment of Miller (1953); the first cell; evolution of prokaryote; origin of eukaryotic cells; evolution of
unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

(4L)

11. **Palentology and evolutionary history:** The evolutionary time scale; eras, periods and epoch; major events in evolutionary time scale; origins of unicellular and multicellular organisms; study of major groups of fossil plants with reference to evolutionary history and general characters of at least single form each group- Pteridospermales, Cyclideoidales, Cordaitales, Pentoxylales, Calamitales. (8L)

12. **Molecular Evolution:** Concepts of natural evolution, molecular divergence and molecular clocks, molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence. (4L)

13. **The mechanisms of evolution:** Population genetics – populations gene pool, gene frequency; Hardy – Weinberg law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modification; isolation mechanisms; speciation; allopatric and sympatricality; convergent evolution; sexual selection; co-evolution. (4L)

**References**

1) Trease & Evans – Pharmacognocy
2) Bradis – Pharmacognocy
3) Hardbourne – Phytochemical methods
4) Daniel M.- Methods in phytochemistry
5) T. Wallis – Textbook of Pharmacognocy
6) Gokhale - Textbook of Pharmacognocy
7) Jain S. K – Ethnobotany
1. **Applied Phycology** – (10 L)
   a) Seaweeds and its applications, sea farming-necessity, principles and methodology.
   b) Algal biotechnology – BGA and its commercial applications, Spirulina – mass production technology and nutritive value.
   c) Algae sewage treatment, Algae causing nuisance, algal blooms, algae as indicators of water quality.

2. **Applied mycology** – (2 L)
   a) Metabolic diversity among fungi, fungal morphology, structure and role of fungi in fungal biotechnology.
   b) **Industrial mycology**
      i) Fermentation technology (Submerged, shallow and substrate fermentation)
      ii) Fungal production of biochemical’s – organic acids, enzymes, vitamins, antibiotics, growth regulators, alcohol, Brewing and wine industry, Ergot alkaloid and its applications.
   c) **Fungal biotechnology** –
      Fungi in mineral biotechnology, fungal SCP, fungi as mycofungicides, mycoweedicides, mycoinsecticides, myconematicides, mycorrhiza and its applications in agriculture, fungal fermented food, white rot fungi in bioremediation, fungi in treatment of effluents, Lignocellulososes conversion in paper industry, mushroom production technology, fungi in coal solubilization, fungal transformation of steroids, particulate absorption by fungi and bisorption.
   d) **Medical mycology** –
      Fungal allergy, fungi in ayurvedic and homeopathic medicines, antitumour and antiviral agents from fungi, fungi as animal and human pathogens – Dermatomycoses (Ringworm), Mycetoma, Candidiasis, Aspergillosis, Mucormycosis.

3. **Statistical methods in Botany** – (8 L)
Measures of central tendency, probability distribution – sampling distribution, difference between parametric and non-parametric statistics, confidence interval, error level of significance, Regression, Correlation, t-test, chi-square test, and ANNOVA.

4. **Computational methods** –

Nucleic acid and protein sequence database, data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation. Overview of bioinformatics, Nature of biological data, Internet searches, search engines (Google, Yahoo) concept in text based searching, bibliographic databases.
1. **Laboratory culture of algae:** Culture of algae: Necessity, types, materials methods, media, isolation techniques, maintenance and growth of algal cultures, synchronous, continuous, mass and in vitro cultures, Method of algal isolation, cryopreservation of algae. Strain selection, Growth kinetics, Measurement of algal growth, (10L)

2. **Production of Algae:** Laboratory to land - Mass multiplication of economically important algae (Rhodophyta, Phaeophyta, Chlorophyta, Cyanophyta) Large scale cultivation, processing, Yield, Chemical composition, Nutrition, quality standards (10L)

3. **Phycoremediation:** Bioremediation, sewage disposal and waste water treatment, textile and effluent sugar industry, (8L)

4. **SCP and Phycocolloides** (2L)

5. **Biofertilizer and seaweed liquid fertilizers.** (2L)

6. **Tissue culture of marine macroalgae-** (4L)

7. **Algae and their biotechnological potential – nutraceuticals, functional food market,** Pharmaceuticals, PUFA, Pigments, enzymes, chemicals and raw material for industries, secondary metabolites, (8L)

8. **Algal biotechnology and entrepreneurship development** (2L)

9. **Algae in hydrogen and hydrocarbon production/ biofuel** (1L)

10. **Seaweed resources of the world & India** (1L)

**References –**

1. P.C. Trivedi, Algal Biotechnology, Pointer publication.
2. C.V. Venkatraman, Algae cultivation and utilization
3. Venkatraman and Bekar, cultivation of algae.
1. **Industrial mycology** – (8 L)
   a) Primary and secondary metabolites of fungi, Fermentation technology – submerged, shallow and solid substrate fermentation.

   b) **Fungal products** –
   Organic acids, enzymes, antibiotics, Gibberellins, Industrial alcohol, Vitamins, Fungi in brewing and wine making, Ergot alkaloids.

2. **Fungal biotechnology** – (18 L)
   Antitumous and antiviral agents from fungi, Immunoregulators (Cyclosporin and Gliotoxin), Fungal transformation of steroids, fungi in Homeopathy and ayurvedic medicines, Fungal single cell proteins, Lignocellulose conversions in the paper industry, coal solubilization, use of yeasts to remove paraffin’s and waxes, fungi in mineral biotechnology, Novel fungal textiles, fungi in treatment of industrial effluents, Detoxification of pesticides using fungal enzymes, white rot fungi in bioremediation, particulate absorption by fungi and its applications, fungi in food industry – SCP, fermented food, mushroom culture, production of flavors and aromas, production of food colorants by fungi, fungi in biocontrol, Mycorrhiza and its application in agriculture.

3. **Fungi and human welfare** – (4 L)
   a) Beneficial and Harmful activities of fungi

   b) Human pathogenic fungi – Superficial mycosis (Tinea and different clinical types), subcutaneous mycosis (mycetoma), systemic mycosis (Aspergilosis, candidiasis, cryptococcosis and mucormycosis).

4. **Fungi as plant pathogens** – (18 L)
   a) Plant diseases – definition, losses caused, classification.

   b) Brief history of plant pathology.

   c) Plant disease symptoms.

   d) Pathogenesis.

   e) Enzymes and toxins in plant diseases.

   f) Physiology of diseases plant.
g) Defense mechanisms in plant.

h) Effect of environment on plant disease.

i) Biotechnology and its role in plant pathology.

j) Study of diseases (Any one from each) Rots, damping off, downy mildevs, white rust, powdery mildews, smuts, bunts, rusts, wilts, leaf spots, leaf blights, anthracnose, Galls, Wart.

k) Seed pathology.
1] Arboretum and Arboriculture  
Arboretum versus Natural forest / Jungle.  
Organization, units and facilities, function importance of an Arboretum  
Basic features of an arborescent form  
Arborescence as a growth type concept and scope of Arboriculture per plantation,  
Plantation maintenance and after are practices in / of arboriculture  
Selection of tree species for plantation Criteria.  
   a. Growth habit and rate, branching pattern, type of bole and foliage- shape and size of a crown, phenology.  
   b. Purpose – special purpose plantation Avenues, Public garden, roadsides, Home garden, Land scalping Forestation, Agroforestry ad a land use system Multipurpose trees.  
Tree Biotechnologies  
   i) Micropropagation  
   ii) VAM application  
   iii) Somatic embryogenesis  
   iv) Andnogensesis  
Identification of trees on gross morphological characters – Branching foliage, Crown, Bard, fruit, seed and other field characters.  

2] Wood anatomy  
Gross structure and organization of wood  
Elements of wood  
Structure of the elements of wood  
Distribution of the elements of wood as seen in TS  
Distribution of the elements of wood as seen in LS  
Properties and uses of wood in relation of structure  
Uses of wood and common Indian trees yielding commercially important woods  
Ultra structure and biochemistry of any one wood element  
Anatomical features of arborescent monocoty leadons
3] Pollen biology, Experimental and applied palynology

- Pollen ultra structure and biochemistry
- Pollen growth and development, maturation
- Pollen germination in vivo and in vitro
- Pollen Viability
- Pollen Sterility
- Pollen Storage
- Pollen biochemistry – Pollen culture
- Pollen based industries
- Mellitolpalynology – Complementarily between floral organization and pollinator, floral fidelity
- Bee forage plants, floral calendar floral fidelity
- Unifloral and multifloral honeys
- Pollen in honey.

4] Reproductive biology, Experimental and applied embryology of angiosperms

- Androgensis
- Gynogenesis
- Endosperm – Ultrastructure, Histocytology, in vitro culture
- Artificial pollination
- Embryo resus
- In vitro fertilization
- Apomixes
- Polyembryony
- Embryogenesis

References:

1) Carliquist, S Ecological strategies of xylem evolution.
2) Cutter, E.G. The plant Antomy, Vol. I and II
3) Dahlgren, R.M.T Families of the monocotyledons and others.
4) Davis, G.L Systematic embryology of Angiosperms.
1) Heslop Harrison J. (ed.) Pollen development and physiology.
3) Hutchinson J.  Evolution and phylogeny of flowering plants.
5) Jane, F.W.  Structure of wood.
6) Johri, B.M (ed) Experimental embryology of vascular plants.
8) Keneth, E.F  Ecology and Resouces management.
9) Kubitzki, K (ed) Flowering plants.
10) Kuijit J.  The biology of parasitic flowering plants.
11) Mahewari P. An introduction to embryology of angiosperms
12) Mahewari P. and Recent advances in the embryology of angiosperm
       Johri, B.M
14) Mulcamy, D.L  Biotechnology and ecology of pollen.
15) Sakurai, K.P  Ornamental trees, their planting care.
16) Rao, C.V  Proteaceae.
18) Robards, W.  Dynamic aspects of plant ultra structure.
19) Sagreiya, K.P  Ornamental trees, their planting care.
20) Scultharpe K.R  Biology of aquatic vascular plants.
       and Johri B.M.
22) Sporne, K.R.  The mysterious origin of flowing plants.
23) Stace, C.A  The taxonomy and Biosystematics
24) Stanley, R.  Pollen Biology, Biochemistry, Management
33) Steward F.C  
Growth and organization in plant.

34) Steward F.C (ed)  
Plant physiology Vol. 6C

35) Street, H.E. (ed)  
Essays in plant taxonomy

36) Subrahmayam K  
Aquatic angiosperms

37) Swingle D.B  
Text book of systematic botany.

38) Zimmerman  
Formation of wood in forest tress.


41) Core, E.L. (1955),  
Plant taxonomy, Prentice – Hall, Englewood Cliffs,

Evolution and classification of flowering plants 2nd edn.  
N.Y. Botanical Garden.

Steps towards a natural system of dicotyledons; embryological characters.

Springler – Verlag, Berlin.

45) Davis, P.H. and Heywood, V.H. (1963) Principles of Angiosperms Taxonomy,  
Oliver and Boyd.

46) Davis, P.H and Heywood V.H. (1973) Principles of Angiosperm, Taxonomy,  

47) Erdtman G. (1996),  

48) Eames, A.J. (1961)  

Plant structure, Function and Adaptation.

Tree care, Macmillan, New York


53) Kubitzki K. (1977)  
Flowering plants Evolution supplement I

54) Lawrence, G.H.M (1951) Taxonomy of Vascular plants., Macmillan


1) **Introduction:** Changing Scenario of climate and Crop Physiology – Concept, Scope and Importance, Recent research in India and Abroad. (4L)

2) **Metabolism:** Photochemical reaction, mechanism of electron transport, pigment aoganzitoin in thylakoid membrane, haeme and chlorophyll – biosynthesis, degradation and its role, Carotenoids – biosynthesis, degradation and its role (8L)

3) Effect of elevated levels of CO\(_2\) and O\(_2\) on net assimilation rate, photorespiration, plant metabolism and crop yield. (4L)

4) Effect of global warming on NAR and crop yield and plant metabolism. (4L)

5) Effect of green house gases and depletion of ozone layer on NAR, plant metabolism and crop yield. (4L)

6) Effect of Allelochemicals (allelobiogenesis) on plant metabolism, soil health and crop productivity under monoculturing. (4L)

7) Effect of fungal, bacterial, viral and mycoplasma infection on plant metabolism. (8L)


BO 4.45 GENETICS, MOLECULAR BIOLOGY AND PLANT BREEDING
(48 LECTURES)
SPECIAL PAPER- II

1. **Molecular mapping of genome**  (9 L)
   Genetic and physical mapping
   Physical mapping and map based cloning
   Choice of mapping population
   Southern hybridization
   Fluorescence In Situ Hybridization
   Chromosome microdissection and microcloning
   Molecular markers in genome and their applications- RFLP, RAPD and AFLP
   Molecular markers linked to disease-resistance genes
   QTL, DNA Fingerprinting

2. **Genome organization**  (5 L)
   Genome size
   Organell genomes
   Genome sequencing
   Analysis of genome sequences
   Nucleic acid purification and analysis
   Analysis of yield of DNA
   Analysis of yield of RNA
   Genome Projects

3. **Nucleic acid Amplification and its application**  (6 L)
   Amplification of plasmid DNA *in vivo*
   Amplification of DNA *in vitro* by PCR.
   Application of DNA amplification
   Cloning of gene
Reverse transcription followed by polymerase chain reaction
Competative PCR
PCR coupled to DNA sequencing
Ligation mediated PCR

4. **Screening Procedure** (3 L)
   - Colony and plaque hybridization
   - Expression screening
   - Hybrid arrest and release
   - Chromosome walking

5. **Characterization of clones** (4 L)
   - Definition
   - Restriction mapping
   - Partial digestion
   - Labeling nucleic acid
   - Southern and Northern blotting – procedure and application

6. **Nucleic acid sequencing** (3 L)
   - Genomic Libraries
   - Sequencing of whole genome
   - DNA sequencing

7. **Breeding for resistance to Abiotic stresses** (8 L)
   - Introduction, Importance and characteristics of abiotic stresses,
   - Minimizing losses due to abiotic stresses
   - Crop Management
   - Development of Resistant varieties
   - Breeding for drought resistance
   - Effects of drought on plant growth and development
   - Types of drought environment
   - Stored moisture environment, Variable moisture environment
   - and Optimal moisture environment
Drought resistance
Drought escape, Dehydration avoidance and Dehydration tolerance
Genetics of drought resistance, sources of drought resistance
Cultivated varieties, Land races, Wild relatives and Transgenes
Relationship between drought resistance traits and yield
selection criteria, Dehydration avoidance, dehydration tolerance
Creation of drought environment
Breeding methods and approaches
Adaptation to a variable environment, combining selection for drought resistance traits and high yield potential
Difficulties in breeding for drought resistance and drought hardening

8. **Breeding for quality Protein**- (6 L)

**Introduction**

Quality traits
Morphological traits, Organolaptic traits, Nutritional quality
Biological quality traits, Other quality traits
Quality traits of selected crops
Breeding for nutritional quality
Enhanced vitamin content - Vitamin A, Vitamin C
Elimination of toxic substances - Lathyism, Favism, Goiter, Trypsin inhibitor
Protein content and quality
Protein content
Protein quality - Amino acid balance of different crops
Biological utilization of proteins
Legume protein improvement
Genetic control of nutritional traits
Oligogenic inheritance, Polygenic inheritance, Maternal effects
Sources of quality traits
A cultivated variety, A germplasm line, A mutant,
A somaclonal variant, A wild relative, A transgene
Breeding approaches

Screening of germplasm, Mutagenesis, Hybridization, Interspecific hybridization, Somaclonal variation

Genetic engineering
modification of seed protein quality, suppression of endogenous genes
biochemical production

Important considerations in breeding for improved quality,
analytical methods, Protein content, Amino acid content, Antinutritional factors, Biological tests

Objectives and priorities
selection criteria for protein content
achievements

Protein content, Protein quality, Antinutritional factors

Limitations of breeding for quality

9. Breeding for quality Oil

Introduction
oils and fats
fatty acids
biosynthesis of fatty acids
oilseed crops
oil yield
oil quality
saturated fatty acid crops, oleic-linoleic crops, euric acid crops
linolenic acid crops
bioengineering considerations
breeding approaches
domestication, selection, mutation, hybridization, interspecific hybridization
biotechnological approaches
micropropagation, somaclonal variation, anther culture, somatic hybridization, genetic engineering, achievements
1) **Molecular Biotechnology** (16L)

   Fundamental aspects, vectors in genecloning and their selection, Geneamplification, PCR and its applications, DNA polymorphism, Use of various enzymes in recombinant DNA technology, Techniques in restriction mapping, southern, Northern, Western, Blotting techniques and applications, DNA libraries, Chromosome walking and jumping, DNA sequencing, Gene Synthesis machines.

2) **Genomics and proteomics** (20L)

   Genomics – Introduction to genomics, sequencing strategies for whole and enome analysis, sequence data analysis

   Comparative Genomics, genome annotation

   Structural and functional genomics

   Pharmacogenomics

   Proteomics – Strategies in proteomics
   - Structural and functional proteomics
   - Proteomics methodologies
   - Applications of proteomics in drug development, screening of diagnostic markers, identification and characterization of novel proteins.

3) **Applications of Biotechnology** - (12L)

   a) Biotechnology in agriculture, ethical aspects, and public acceptance, bioethical principles of agricultural biotechnology
b) Biological nitrogen fiction, mechanism, nod genes, nifgenes, hugeness, use of microbes in industry and agriculture.

c) Use of biotechnology in environmental protection, pollution control, waste water treatment, microbes in leaching of metals, economics and legal issues of biotechnology.
BO: 4.47 Plant Biodiversity (Special paper -II)  
(Plant Biodiversity Conservation) (48 Lectures)

1. Loss of Biodiversity  
   Introduction  
   Loss of Genetic Diversity: Introduction, Factors causing loss of Genetic Diversity, Founder Effects, Demographic bottlenecks, Genetic Drift, Inbreeding Depression  
   Loss of Species Diversity: Introduction, Process Responsible for Species Extinction, Population Size as a Critical Factor in Species Extinction  
   Introduction  
   MVP and Population Viability Analysis  
   Meta-population Concept  
   Current and Future Species Extinction Rates  
   Threatened Species: IUCN Threatened Categories and ‘Unknown’ Categories, Census of Threatened Species, Common Features of Threatened Species  
   Loss of Ecosystem Diversity: Factors Affecting Ecosystem Degradation and Loss  
   Loss of Agro-biodiversity  
   Loss of Biodiversity as an Economic Process

2. Conservation of Biodiversity  
   Why Conservation and Conservation Biology?  
   Current Practices in Conservation  
   Conservation of Genetic Diversity, Species Diversity, Ecosystem Diversity  
   In-situ and ex-situ Conservation  
   In-situ Conservation: Protected Areas: Introduction, Biosphere Reserves and National Parks, On-farm and Home Garden Conservation  
   Ex-situ Conservation: Germplasm Collections, Botanical Gardens, Seed Banks  
   Test-tube Gene Banks, Pollen Banks, Field Gene Banks, DNA Banks, In-vitr Conservation Methods, Ecosystem Restoration  
   Social Approach to Conservation and Indigenous Knowledge Systems: Sacred Groves, Sthalavrikshas, People’s Movement for Biodiversity Conservation, Chipko Movement, Chico River Dam and Tribal Campaign, Participatory Forest Management  
   Role of Universities and other Educational Institutions in Biodiversity Conservation such as Biodiversity Awareness Programmes and Biodiversity Education Resources, Media, Concept of Sustainable Development
3. **Management of Plant Biodiversity**

Introduction

Organizations Associated with Biodiversity Management

Organizations Primarily Involved in Framing Policies and Methodologies for Execution: IUCN, UNEP, UNESCO, WWF, ICSU, FAO, CAB International, WCMC, ISBI

Organizations Involved in Financing Biodiversity Management: GEF, WHF


Databases: Taxonomic Databases Working Groups for Plant Sciences SA2000, Databases on Biodiversity, Distribution of Biodiversity Information, Metadatabases, Virtual Libraries, Special Interest Networks, Biodiversity Application Software, CD-ROMs and Diskettes, Thesauri.

4. **Biological invasions:**

Introduction, Concepts to understand and predict a global threat:

Ecological, Evolutionary and Economic impacts, Human health impact, examples of biological invasions

5. **Biodiversity and Biotechnology**

Introduction

Biotechnology and its Role in Assessment of Biodiversity and Bioresources

Biotechnology and Its Role in Biodiversity Conservation

Biotechnology and its Role in Utilization of Biodiversity

Adverse Impacts of Biotechnology on Biodiversity: Direct Impacts, Indirect Impacts Eco-terrorism

6. **The Economics of Biodiversity Conservation**

Introduction, Economics of biodiversity Exploitation, Economic value of biodiversity, Valuation of biodiversity

Plant biodiversity as a source for Carbon Sinks, Carbon sequestration, Carbon credits, and Clean Development Mechanism (CDM)

7. **Values and Uses of Biodiversity**

Introduction

Biodiversity Values

Ethical and Aesthetic Values
Precautionary Principle
Methodologies for Valuation of Biodiversity: Changes in Productivity Method, Contingent Valuation Method, Hedonic Pricing Method, Travel Cost Method
Uses of Plants: Introduction, Food, Fodder and Forage, Timber, Rattans and Canes, Medicinal Plants, Ornamentals, Other Uses
Ecotourism and agroforestry

8. **Biodiversity Prospecting and Indigenous Knowledge Systems** 3L
Bioprospecting, Indigenous Knowledge Systems, Bio-piracy
IPR’s and Ownership of Traditional Knowledge Traditional Resource Rights
Problems and Prospects in Participatory Management of Biodiversity

9. **Legal and political scenario** 3L
Legislations; international agreements for the protection of species and habitats; Biodiversity Act; Forest Act, Wildlife Act, CBD, Emerging International Policies
BO 4.4 PRACTICALS BASED ON 4.1 AND 4.2

Plant Resources and Evolution (12 Practicals)

1) Study of any two plants from each with botanical name, common name and importance. Food fodder, fibre, spice, edible oil, latex, medicine, gum, starch. (2P)

2) Study of timber plant wrt morphological and anatomical characters (1P)

3) Extraction of essential oil by Soxlet method from any two plant (1P)

4) Study of any six plants of pharmacognostic value with their macroscopic, microscopic characters. (1P)

5) Qualitative and quantitative analysis of Starch, Proteins, Oils, Tannins, Phenols (2P)

6) Isolation and separation of alkaloids by TLC (Datura/ Tobacco) (1P)

7) Study of any six herbal medicines in market (1P)

8) Study of different plant fossils with respect to evolution (1P)

9) Study of mutation and polymorphism with suitable examples. (1P)

10) Visit to BSI, medicinal and aromatic plant garden, submission of report. (1P)

Applied Botany (12 Practical)

1) Isolation and maintenance of any two nitrogen fixing BGA. (1P)

2) BGA biofertilizer production technology (1P)

3) Isolation and maintenance of Spirulina. (1P)

4) Estimation of algal proteins. (1P)

5) Study of any four industrially important fungi and their products. (1P)

6) Study of saprotrophs (any two), necrotrophs (any two). (1P)

7) Study of any six-plant diseases such as leaf spot, rust, smut, downy mildews, powdery mildews, rots. (1P)

8) Study of citric acid fermentation by spectrophotometry. (1P)

9) Analysis of data for measure of variation, mean, mode, standard deviation, chi square test, t-test, estimation of probability. (2P)

10) Introduction to NCBI, BLAST and FASTA (1P)

11) Searching for gene/protein sequence (1P)
BO 4.5 PRACTICALS BASED ON SPECIAL PAPER PHYCOLOGY II BO 4.41

1. Survey of market products of algal material (2P)

2. DNA extraction and its quantification by using suitable algal material (2P)

3. RNA extraction and quantification by using suitable algal material (2P)

4. Culture methods (4P)

5. Culturing algae *Spirulina / Chlorella / Scenedesmus / Botryococcus.* (2P)

6. Biochemical analysis of the cultured algae for food/biofule properties. (3P)

7. Separation of proteins from algae by using SDS –PAGE electrophoresis technique. (3P)

8. Protoplast isolation and fusion. (2P)

9. Visit to commercial algal production unit and submission of report (2P)
BO 4.5 MYCOLOGY AND PLANT PATHOLOGY PRACTICAL PAPER II

1. Staining and isolation of VAM. (1 P)

2. Cultivation of *Pleurotus* on different substrates (2 P)

3. Study of any one disease from each of the following – Rots, Wilts, downy mildews, powdery mildews, leaf spots, tar spots, warts, galls, Ergot, rusts, bunts, smuts, blight, damping off, white rust, anthracnose with reference to symptoms, causal organism and control measure if any. (9 P)

4. Study of polyphenol oxidase activity from diseases and healthy plant. (2 P)

5. Study of citric acid production by titrimetric and spectrophotometric method. (2 P)

6. Study of fungal originated medicines. (1 P)

7. Study of yeast fermentation by inverted tube method on different substrates (glucose, maltose, sucrose). (2 P)

8. Study of penicillin fermentation by chemical and iodometric assay. (2 P)

9. Study of any five research papers concerned with mycology and plant pathology and prepare review to present on LCD and prepare a report. (2 P)

10. Visit to fermentation industry and institute and submission of excursion report. (1 P)
1] Preparation of artificial keys to identify trees (at least 10 for key) (1P)

2] Germination of seed of at least one plant species, maintenance of seedling (1P)

3] Visit to a nearby forest. (1P)

4] Designing for a botanical garden for an educational institute/ research institute. (1P)

5] Preparation of micropreparation (T.S., TLS RLS and wood elements) of a wood of a species. (Preferably timber) (3P)

6] Preparation of a key, based on anatomical characters, to identify, woods (1P)

7] Pollen germination in vitro (1P)

8] Pollen germination in vitro (1P)

9] Testing pollen viability, sterility (2P)

10] Pollen analysis of honey sample (1P)
11] In vitro culture of anthers
(2P)

12] Dissection and mounting of multiple embryos
(1P)

13] Histochemical analysis of endosperm
(1P)

14] Dissection and isolation of free nuclear endosperms
(1P)

(1P)
2. Estimation of carotenoids in C$_3$ and C$_4$ plants.  
3. Determination of allelopathic potential of native and invasive weeds by using seed germination bioassay.  
4. Estimation of total sugars from C$_3$ and C$_4$ plants.  
5. Identification of allelochemicals in invasive weeds by qualitative phytochemical tests.  
7. Estimation of total phenols in healthy and bacteria infected plants.  
8. Estimation of free amino acids in healthy and viral infected plants.  
11. Protein profiling of normal and transgenic cotton by SDS- PAGE.  
12. Protein profiling of healthy and infected plants by SDS- PAGE.  
13. Determination of carbohydrates during different stages of flowering (during formation of floral buds and fully open flowers.).  
14. Estimation of protein during different stages of flowering (during formation of floral buds and fully open flowers.)
1. Isolation and purification of plant genomic DNA (1 P)
2. DNA Ligation (1 P)
3. Restriction Mapping (2 P)
4. Southern Blotting (2 P)
5. Western Blotting (2 P)
6. Study of DNA polymorphism by RFLP (2 P)
7. Transformation - Competent Cell Preparation and cloning in suitable vector and screening of recombinants (Blue White Screening) (3 P)
8. Gene amplification by polymerase Chain Reaction. (1 P)
9. Estimation of proline from any drought resistant variety of pulses. (1 P)
10. Estimation of glycine betain from any drought resistant variety of pulses. (1 P)
11. Study of antinutritional factor from any suitable plant materials (pulses) (2 P)
12. Screening of drought resistant varieties of any suitable plant material for % germination root/shoot ratio, total seedling height and survival rate. (1 P)
13. Protein profiling by SDS-PAGE of any drought resistant variety. (1 P)
14. Agrobacterium Mediated Genetic Transformation (3 P)
15. Visit to Molecular Biology Research laboratory or Biotechnology research laboratory (1 P)
1) Isolation of genomic DNA     (2 P)
2) DNA detection and purification by gel electrophoresis.
3) DNA Estimation –         (10 P)
4) Isolational proteins       (2 P)
5) Isolation of Plasmid DNA   (2 P)
6) Restriction digestion of DNA  (2 P)
7) Collection identification and conservation of land races of crop plants (2 P)
8) Study of any 5 research papers from international Journal of biotechnology and preparation abstract, review and presentation on LCD     (2 P)
9) Preparation of questionnaire for acceptance or non-acceptance of biotech procut. (2 P)
10) Isolation and culture of any two industrially important microorganisms – (2 P)
11) Visit to biotech industries, institutes agro-biotech fields, and submission of report. (2 P)
12) Electrophoresis of RNA on denaturing gels     (2 P)
13) Electrophoresis of RNA on denaturing gels     (2 P)
BO 4.5 PRACTICALS BASED ON SPECIAL PAPER BO 4.47 SPECIAL PAPER- II (PLANT BIODIVERSITY)

1. Analysis of aquatic vegetation studies, Algae and fungi  
   (3P)
2. Estimation of algal and fungal species diversity in soil samples.  
   (2P)
3. Study of vegetation including lower groups by belt transect along slope gradient  
   (2P)
4. Study the biomass profile of the plants in an herbaceous ecosystem.  
   (1P)
5. Find out the similarity and dissimilarity Index.  
   (1P)
6. Prepare the shoot/canopy profile of a tree stand along a line transect.  
   (2P)
7. Find out various diversity indices with the help of computer software.  
   (2P)
8. Remote sensing technique for vegetation/ plant diversity assessment using satellite imagery and aerial photographs  
   (2P)
9. Construction of quadrat - to study the percentage of frequency, density, abundance and their relative values of forest communities. Prepare their frequency class diagram and compare them with Raunkiaer’s Normal Frequency Diagram and also find out the Simpson’s Index of Dominance.  
   (4P)
10. Field trips to places for study and observation of vegetation types (including any one plant diversity hotspots / National Parks/ Wildlife Sanctuary) prescribed in the syllabus for 2 to 5 days under the guidance of teachers. Preparation and submission of field visit report.  
    (4P)

(Subscription of any five forms from Pteridophytes, Gymnosperms and Angiosperms, is compulsory. Preparation and submission of field visit report at the time of practical examination is must.)