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, definations 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 in to 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, sporogenus tissue, microspores, male germ unit.
   b) Development of carpel, ovule, sporogenus tissue, megaspore- female gametophyte – female germ unit.
5. **Fertilization** **(3L)**
   a) Double fertilization and triple fussion – Interactions, pollen – stigma, pollen tube – stigmatic tissue, style, overy ovule, female gametophyte, sperm cell – egg, central cell, syngamy.

b) Zygote – Ultrastructure, patterns of development till globular stage, establishment of embryonal root – shoot meristem – shoot initiation and development of cotyledons.

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 studing 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)**

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.

Somatic hybrids (symmetric and asymmetric), cybrids (**3L)**

8. Somaclonal variation – introduction, types, causes, selection methods, (**2L)**
9. Applications – Micropropagation, production of diseasae/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/G M crops. Applications of PTC in Agriculture, Horticulture, Floriculture, Forestry, Medicinal and Aromatic plants etc. (**4L)**

BO 3.2 ENVIRONMENTAL BOTANY AND PLANT DIVERSITY [48L]

ENVIRONMENTAL BOTANY (32L)

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 **(3L)**
2. **Ecosystem Structures and Functions:** Biotic, Abiotic structures, functions, energy flow, energy models, ecological pyramids, Biogeochemical cycles (N, P, C, K, H_2O), Nutrient budget and ecosystem, Ecological succession: types, mechanism of succession, concept of climax, ecological stability, Ecological habitat and ecological niches, ecotone, Characteristic features of ecotonal communities. Interconnectedness of ecosystems, Types of ecosystems wrt biotic abiotic relationship in the Terrestrial – [Grasslands, Savanas, Deserts, Forest types etc]. Aquatic- [Lentic, Lottic, Brakish water and Marine, Mangrove ecosystems.] **(10L)**
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. **(8L).**
4. **Population Ecology:** Characters of population, Density, Dispersion, Natality, Mortality, Survivorship curve, Population growth and limits. Factors responsible for Natality and Mortality, Age structure.
5. **Community Ecology-** Forms and structure of communities, Guild, Physiognomy, classification of communities, functional aspects of communities- seasonal, periodism, phototropism and metabolism **(3L)**
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. **(2L)**

   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. **(2L)**

   c) Soil pollution: sources and types of soil pollutants and its impact on soil quality **(1L)**

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: (**1L**)

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**)

13. **Restoration ecology:** Definition and principles of ecological succession in restoration ecology. Role of mycofertilizers and soil ecology, selections of plants and microbes in restoration ecology. Concept of phytoremidation, phyto extraction, phyto filtration, phytoaccumulation in remediation of wastewater and degraded soils with examples. **(4L)**

References Books

1) J. S. Singh, S. P. Singh and S. R. Gupta, Ecology, environment and resource conservation by Anamya publication , New Delhi.

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
6) Odum, E. P. 1971. Fundamentals of Ecology, Saunders, Philadelphia
7) Odum, E. P. 1983. Basic Ecology, Saunders, Philadelphia.
8) Chapman, J. L. and Reiss, M. J. 1988, Ecology, principles and Applications, Cambridge University Press, Cambridge, U. K.
9) Heywood, V. H. and Watson, R. T. 1985. Global Biodiversity Assessment, Cambridge University Press, Cambridge, U. K.
10) Treshow, M. 1985. Air pollution and plant life, Wiley Interscience.
11) Das. Concept of ecology
12) Nebel, B. J & Wright, R. T. 1981,Environmental Science – the way the world work Prentice Hall.

BO 3.31 PHYCOLOGY SPECIAL PAPER - I

(48Lectures)

1. Approaches to algal systematic – Origin, evolution and phylogeny, Algae in food webs and other biotic associations Histochemistry, Ultrastructure, Flagella architecture, cell division, Endosymbiosis and origin of eukaryotic algae. distribution and classification with reference to range, structure, life-history, Tools in algal taxonomy, Phylogeny, Molecular Systematics and Applications, (**12L)**

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**)

4. Ecology – Ecological classification of algae, Physiochemical features of water, Periodicity and succession of algae, algae of running water, Intertidal algae and zonation pattern. Phytoplankton ecology; Intertidal ecology; Paleolimnology. (**12L**)

References

1) Charles D. Amsler Algal Chemical Ecology

2) Dawes, CJ 1981.Marine Botany, New York: Wiley.

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

4) Gilbert Morgan Smith (1951), Manual of Phycology an introduction to the algae and their biology.

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

6) M. J. Dring, The Biology of Marine Plants.

7) Mark M. Littler, Janet R. Stein-Taylor, Handbook of Phycological Methods: Ecological Field Methods: Macroalgae, Phycological Society of America.

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

9) R. Jan Stevenson, Max L. Bothwell, Rex L. Lowe (1996), Algal ecology: freshwater benthic ecosystems

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

11) Robert Edward Lee (2008),Phycology

12) Susan E. Douglas, A. W. D. Larkum, John A. Raven, Photosynthesis in algae.

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

14) Carole A. Lembi, J. Robert Waaland, Algae and human affairs, Phycological Society of America.

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)**

2. **Fungal systematics** – Systematics of Myxomycota, Mastigomycotina, Zygomycotina, Ascomycotina, Basidomycotina, Deuteromycotina, Lichens, wrt. Classes, orders, thallus organization, reproductive organization if any. **(24L)**

3. **Heterothallism and phylogeny in fungi – (5 L)**

   a) Heterothallism in mucorales, oomycetes, basidiomycetes.

   b) Algal and protozoan ancestry, Biochemical support for evolutionary relationships in fungi – Zygomycetes, Ascomycetes and Basidiomycetes.

4. **Fungal ecology – (8L)**

   Colonization strategies, fungal habitats, fungal association with higher plants, algae and insects, rhizosphere, phylloplane, seed and air borne fungi, soil fungi,

5. **Fungal Genetics – (4L)**

   Fungi as tools of genetical studies, genetical aspects of pathogenecity and host resistance, virulence.

6. **Fungal physiology – (4L)**

   Fungal nutrition (Carbon, nitrogen & minerals), mycotoxins, sex hormones, fungal growth.

B0. 3.33 ANGIOSPERMS SPECIAL PAPER – I (48L)

1] ICBN **(12L)**

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 **(12L)**

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 **(12L)**

Aims, objectives and procedures of Biosystematics investigation. Clausen's experiments, Biosystematics categories – Comparison with taxonomic categories. Analysis of Biosystematics data. Numerical taxonomy.

4] A) Botanical Gardens **(12L)**

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

BO 3.34 PLANT PHYSIOLOGY (SPECIAL PAER – I)

(48 Lectures)

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, Imporatnce.
   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 Imporatnce.
   Effect of air pollutants on plant metabolism. **(6 L)**

Reference books –

1. Introduction to Plant Physiology by William G. Hopkins, Published by – John Wiley and Sons, Inc. (1995)
2. Plant Physiology (3rd edition) by Lincoln Taiz and Eduardo Zeiger, Published by – Panima Publishing Corporation (2003).
3. Plant Physiology by R. G. S. Bidwell (revised edn.)

BO 3.35 GENETICS, MOLECULAR BIOLOGY AND PLANT BREEDING

(48 LECTURES)

SPECIAL PAPER- I

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, M $_{13,}$), 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, Accerssory chromosomes

3. Karyotype (**2 L)**

Defination, importance

Evolution of Karyotype

All types of banding patterens 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 ploydoids.

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 T_4 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 **(18 L)**

8. General consideration of Plant breeding – **(2 L)**

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 - **(3 L)**

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 **(5 L)**

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 evalution techniques **(3 L)**

Design for yield and agronomic evalutions and their analysis. Completely randomized block, lattice and latin square designs and factorial experimental designs.

12. Mutation in Crop Improvement - **(3 L)**

Introduction

Treatment methods, predictions concerning outcome of mutagenic treatments, s 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 **(2 L)**

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, axillory bud culture, protocol and schedule of observation, some clonal variation, selection. **(8 L)**
    c) Micro Propagation – Advantages of tissue culture technique over convetional 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. **Cryopresorvation –** importance, methods, future prospects. **(4 L)**
6. Phytoremediation, single cell proteins, bioferklizers – mycorrhiza, BGA - **(4 L)**

BO: 3.37 PLANT BIODIVERSITY (SPECIAL PAPER – I)

(Fundamentals of Biodiversity) 48 Lectures

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 Inventorying 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** **(4L)**
   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** **(8L)**
   Introduction
   Classification of Ecosystems
   Measuring Ecosystem Diversity
   Major Ecosystem Types of the World: Tropical Moist Forests, Temperate Forests, Arid and Semiarid 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:** **(6L)**
   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:

1. Handbook of the Convention on Biological Diversity (2001), Secretariat of the Convention on Biological Diversity. Earthscan publ., London
2. Environmental Management (2003), N.K. Uberoi, Excel Books, New Delhi
3. An Advanced Textbook on Biodiversity-Principles and Practice (2003), K.V. Krishnamurthy, Oxford & IBH Publ. New Delhi
4. Biodiversity and Conservation (2005), Michael J. Jeffries, Routledge, London
5. Handbook of Biodiversity Methods – Survey, Evaluation and Monitoring (2004) Edt.- David Hill, Matthew Fasham, Graham Tucker, Michael Shewry & Philip Shaw; Cambridge
6. Global Biodiversity Assessment (UNEP) by-Heywood V. (edt)
7. Understanding Biodiversity- Life, sustainability and Equity (1997) Ashish Kothari; Orient Longman
8. Environmental Ethics (1994) Dwivedi O.P; Sanchar Publishing House, New Delhi
9. Global Biodiversity: Status of the Worlds Living Resources (1992); WCMC; Chapman and Hall, London
10. This Fissured Land: An Ecological History of India (1992) Gadgil M. & Guha R.; Oxford University Press, New Delhi
11. Restoration of Endangered Species (1996) edt- Bowles M.L. & Whelan C.J.; Cambridge Univ. Press.

12. Preservation and Valuation of Biological Resources (1990); Orians GH, Brown GM, Kunin WE & Swierbinski JE.; Univ. Washington Press
13. Paradise Lost? The Ecological Economics of Biodiversity (1994); Barbier EB, Burgess JC & Folke C.; Earthscan, London
14. Molecular Markers, Natural History and Evilution (1994), Avise JC; Chapman & Hall, London
15. Forest Genetic Resources: Status, Threats and Conservation Strategies (2001), Uma Shaanker, R. Ganeshiah, KN. & Bawa KS (Eds); Oxford & IBH, New Delhi
16. Global Biodiversity Strategy: Guidelines for Action to Save, Study, and Use Earth's Biotic Wealth Sustainably and Equitably (1992) WRI/IUCN/UNEP; WRI Publ, Baltimore, MD.
17. Plant Diversity Hotspots in India – An Oversview (1997) Edt.- Hajra P.K. & V. Mudgal, BSI
18. Biomass Studies – Field Methods for Monitoring Biomass (1997), Shailaja Ravindranath & Sudha Premnath. Oxford & IBH, New Delhi.
19. Ecological Census Techniques – A Handbook (1997). William J. Sutherland. Cambridge Uni. Press.
20. Status, Conservation & Management of Wetlands (2002). T.V. Ramchandra, R. kiran, N. Ahalya., Allied Publ. New Delhi.
21. Biomarkets – 43 Market Forecasts for Key Product Area (1991). Technical Insights Inc.
22. Statistical Ecology (1988). John A. Ludwig & James F. Reynolds. John Wiley 7 Sons.
23. Plant Ecology (1938). John E. Weaver & F.E. Clement. Mc Graw-Hill. NY.
24. Ecological Diversity & Its Measurement (1988). Magurran Anne. Chapman & Hall India
25. Ecological Methods for field & Laboratory investigations (1984) Michael P., TMH Co. ltd. Bombay.
26. Wetlands: Functioning, Biodiversity conservation, and Restoration (2006), R. Bobbink, B. Beltman, J.T.A. Verhoeven and D.F. Whigham (Eds), Springer, New York.
27. The Economics of Biodiversity Conservation (2007), K.N. Ninan, Earthscan, London.

BO 3.4 PRACTICALS BASED ON DEVELOPMENTAL BOTANY AND PLANT TISSUE CULTURE (BO. 3.1) & ENVIRONMENTAL BOTANY AND PLANT DIVERSITY (BO.3.2)

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,megasoporogensis 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 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)**

BO 3.5 PRACTICALS BASED ON SPECIAL PAPER PHYCOLOGY - I BO 3.31

1) Quantification of phytoplankton:– by using single drop method / Lackeys 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)**

BO 3.5 MYCOLOGY AND PLANT PATHOLOGY PRACTICAL PAPER I

1. Isolation of aquatic and soil fungi by baiting method **(1P)**

2. Study of heterothallism . **(1P)**

3. Isolation of soil fungi by soil dilution method. **(1P)**

4. Isolation of phylloplane fungi by leaf impression method. **(1P)**

5. Isolation of fungi from rhizosphere and non-rhizosphere soil. **(2P)**

6. Measurement of fungal growth by linear determination and weight determination method. **(2P)**

7. Effect of light on growth and sporulation of fungi. **(1P)**

8. Isolation of plant pathogenic fungi from leaves, stem, fruits and soil **(2P)**

9. Study of any four myxomycetes, chytridiomycetes. Zygomycetes, Ascomycetes. Basidiomycetes, Deuteromycetes, Lichens. **(10P)**

10. Study of any forest and crop systems to identify and collection of fungi and submission of excursion report. **(1P)**

11. Study of seed borne fungi and post harvest pathogens of any four fruits and vegetables each. **(2P)**

B0 3.5 ANGIOSPERMS SPECIAL PAPER I – PRACTICAL BASED ON B 03.33

1] Classification and identification of at least 3 species of *Sida, Indigofera, Cassia, Solamum, 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**)

4] Taxonomic distribution of peculiar embryological features – Jaculator , composite endosperm, hypostase, nucellar beak, pseudomonad. (**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**)

BO 3.5 PRACTICALS BASED ON PLANT PHYSIOLOGY SPECIAL PAPER - I (BO 3.34)

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^{+}, Ca^{++} 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 acetoorcein 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 Bryopytes, 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**: Lamaeck; Darwin –concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontanety 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 al least single form each group- Pteridospermales, Cycldeoidales, 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 Pharmacgnocy
6) Gokhale - Textbook of Pharmacgnocy
7) Jain S. K – Ethnobotany

BO – 4.2 APPLIED BOTANY (48 LECTURES)

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 nuissance, 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, Lignocelluloses conversion in paper industry, mushroom production technology, fungi in coal solubilization, fungal transformation of steroids, partriculate 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, conifidence interval, error level of significance, Regression, Correlation, t-test, chi-square test, and ANNOVA.

4. Computational methods – (10 L)

Nucleic acid and protein sequence data base, data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation. Overview of bioinformetics, Nature of biological data, Internet searches, search engines (Google, Yahoo) concept in text based searching, bibiliographic databases.

BO 4.41 PHYCOLOGY SPECIAL PAPER - II

(48Lectures)

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 pulication.
2. C.V. Venkatraman, Algae cultivation and utilization
3. Venkatraman and Bekar, cultivation of algae.

BO 4.42 Mycology and Plant Pathology Special Paper II

(48 Lectures)

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 ayuvedic 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, cryptococosis 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.

B0 4.43 Angiosperms Special Paper – II (48L)

1] Arboretum and Arboriculture (12L)

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 (12L)

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 (**12L**)

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

Mellitopalynology – 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 (**12L**)

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.

5) Froagin. I. Text – book of pollen analyses.

6) Heslop Harrison J. (ed.) Pollen development and physiology.
7) Hutchinson. J Families of flowering plants, Vol. I and II.
8) Hutchinson J. Evolution and phylogeny of flowering plants.
9) Jain, S.K and Rao. R.R. Handbook of field and Herbarium methods.
10) Jane, F.W. Structure of wood.
11) Johri, B.M (ed) Experimental embryology of vascular plants.
12) Johri, B.M (ed) Embryology of Angiosperms.
13) Keneth, E.F Ecology and Resouces management.
14) Kubitzki, K (ed) Flowering plants.
15) Kuijit J. The biology of parasitic flowering plants.
16) Mahewari P. An introduction to embryology of angiosperms
17) Mahewari P. and Johri, B.M Recent advances in the embryology of angiosperm
18) Malik, C.P (ed) Physiology of sexual reproduction in flowering plants.
19) Mulcamy, D.L and Others Biotechnology and ecology of pollen.
20) Nair, P.K.K Advance in plant science
21) Nair. P.K.K Recent advances in pollen spore research Vols. I, II & III
22) Prione, P.P Tree maintenances
23) Raghvan, V. Experimental embryogenesis in vascular plants.
24) Rao, C.V Proteaceae.
25) Rendle, A.B. The classification of flowering plants, Vol. I & II.
26) Robards, W. Dynamic aspects of plant ultra structure.
27) Sagreiya, K.P Ornamental trees, their planting care.
28) Scultharpe K.R Biology of aquatic vascular plants.
29) Shivanna, K.R. and Johri B.M. The angiosperms pollen – Structure and function.
30) Sporne, K.R. The mysterious origin of flowing plants.
31) Stace, C.A The taxonomy and Biosystematics
32) 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 taxanomy
36) Subrahmayam K Aquatic angiosperms
37) Swingle D.B Text book of systematic botany.
38) Zimmerman Formation of wood in forest tress.
39) Benson L. (1957). Plant classification. Oxford and IBH Co., New Delhi.
40) Chowdhury and Ghosh (1958). Indian woods, Vol. I. Government of India.
41) Core, E.L. (1955), Plant taxonomy, Prentice – Hall, Englewood Cliffis,
42) Cronquist A.J. (1988) Evolution and classification of flowering plants 2nd edn. N.Y. Botanical Garden.
43) Dahlgren, G (1991). Steps towards a natural system of dicotyledons; embryological characters.
44) Dahlgren R.H.T. Clifford a P.F. Yeo (1985). The families of Monocotyledons 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, Robert E.Krieger publishing Company Huntington, New York.
47) Erdtman G. (1996), Pollen Morphology and plant Taxonomy Angiosperm (An introduction to Palynology I.) Hafner Pub. Co. London.
48) Eames, A.J. (1961) Morphology of Angiosperm, Mc Grew Hill Book Company.
49) Hall, M.A (1976). Plant structure, Function and Adaptation.
50) Haller, J.M. (1959). Tree care, Macmillan, New York
51) Hutchinsoon J (1969). Evolution and phylogeny of flowering plants. Acad. Press, London.
52) Jones, S.B and Luchinger A.E. (1986) Plant Systematics 2nd edn Mc Graw Hill Book Co.
53) Kubitzki K. (1977) Flowering plants Evolution supplement I
54) Lawrence, G.H.M (1951) Taxonomy of Vascular plants., Macmillan

55) Mabberly, T.J. (1997) The Plant Book 2nd edn Cambridge University Press, Cambridge.

56) Naik, V.N. (1984). Taxonomy of Angiosperms Tata McGraw Hill, New Delhi,

57) Smith P.M. (1976) The chemotaxonomy of plants Edward Arnold Pub. Ltd.

BO – 4.44 PLANT PHYSIOLOGY (SPECIAL PAPER - II)

(48 Lectures)

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 aoganizatoin 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)**
8) Defense mechanisms in host plants – Defense chemicals, structural defense, R-genes, systemic acquired resistances (SAR). HR, (Hypersensitive response)
   Transgenic for insect and disease resistance – Bt-cotton, Bt-brinjal, Bt-rice, Bt-tomato. **(6L)**
9. Flowering physiology- Photoreceptors, phytochromes, cryptochromes and their biochemical and photochemical properties. Photoperiodism and its significance in flowering, circadian clock and its regulation. **(6L)**

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

   Flourescence 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

   Population genetics – Genetic variability & Evolution, polymorphism, gene-environment interactions.

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- Lathyrism, 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

achievemnts

Protein content, Protein quality, Antinutritional factors

Limitations of breeding for quality

9. Breeding for quality Oil (4 L)

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

BO 4.46 PLANT BIOTECHNOLOGY SPECIAL PAPER – II

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 libraties, Chronmosome walking and jumping, DNA sequencing, Gene Synthesis machines.

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

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

Comparative Generics, genome annotation

Structural and functional genemics

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 **12 L**

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

Reasons for Loss in Diversity of Major Ecosystems of the World: Tropical Forests, Grasslands, Inland Wetlands, Mangrove Ecosystem, Arctic and Alpine Systems, Boreal Forests, Temperate Forest Systems, Arid and Semiarid Lands

Loss of Agro-biodiversity

Loss of Biodiversity as an Economic Process

2. Conservation of Biodiversity **8 L**

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 **10 L**

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

Biodiversity Legislation and Conventions: Introduction, International Biodiversity Law

Convention on Biological Diversity, Trade-related Intellectual Property Rights

CITES, Ramsar Convention, International Undertaking on Plant Genetic Resources and Farmers Rights, UPOV Convention and the Rights in Plants Varieties, ITTA and ITTO, Problems Related to Legal Status of Plants, Plant Collection and Trade Controls

National Legislation: Environmental Protection Act 1986, Biodiversity Act, Biodiversity Rules and Regulations.

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:** **3L**

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 **3L**

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 **2L**

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 **4L**

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 sphectrophotometric 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)**

B0 4.5 ANGIOSPERMS SPECIAL PAPER II – PRACTICAL

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)

15] Dissection and isolation of suspensor haustoria.

(1P)

BO 4.5 Practicals based on special paper Plant Physiology II (BO 4.44)

1. Estimation of chlorophyll A, Chlo. B, total chlorophylls and Chlo. A/ B ratio in C_3 and C_4 plants. (**2P)**
2. Estmation of carotenoids in C_3 and C_4 plants. (**2P)**
3. Determination of allelopathic potential of native and invasive weeds by using seed germination bioassay. (**2P)**
4. Estmation of total sugars from C_3 and C_4 plants. (**2P)**
5. Identification of allelochemicals in invasive weeds by qualitative phytochemical tests. (**1P)**
6. Estmation of reducing sugars in healthy and fungal infected plants. (**1P)**
7. Estimation of total phenols in healthy and bacteria infected plants. (**1P**)
8. Estimation of free amino acids in healthy and viral infected plants. (**1P**)
9. Estimation of polyphenol oxidase (PPO) activity in healthy and diseased plants. (**2P**)
10. Determination of IAA oxidase activity in healthy and mycoplasma infected plants. (**2P**)
11. Protein profiling of normal and transgenic cotton by SDS- PAGE. (**2P)**
12. Protein profiling of healthy and infected plants by SDS- PAGE. (**2P**)
13. Determination of carbohydrates during different stages of flowering (during formation of floral buds and fully open flowers.). (**2P**)
14. Estmation of protein during different stages of flowering (during formation of floral buds and fully open flowers.) (**2P**)

BO 4.5 PRACTICAL BASED ON GENETICS, MOLECULAR AND PLANT BREEDING SPECIAL PAPER 4.35

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 **(1P)**

BO 4.5 PRACTICALS BASED PLANT BIOTECHNOLOGY SPECIAL PAPER II

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 procuct. **(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)**

(Submission 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.)