Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure For M. Sc. I (Botany)

Semester	Paper Code	Title of Paper	No. of Credits
I	BOT4101	Plant Systematics I	4
	BOT4102	Cell Biology	4
	BOT4103	Genetics and plant Breeding	4
	BOT4104	Advanced Botanical techniques	4
	BOT4105	Practicals based on BOT. 4101 and BOT. 4102	4
	BOT4106	Practicals based on BOT. 4103 and BOT. 4104	4
II	BOT4201	Plant Systematics II	4
	BOT4202	Plant Physiology and Biochemistry	4
	BOT4203	Molecular Biology and Genetic Engineering	4
	BOT4204	Plant Ecology and Biodiversity	4
	BOT4205	Practical on BOT 4201and BOT4202	4
	BOT4206	Practical on BOT 4203 and BOT 4204	4

SYLLABUS (CBCS) FOR M. Sc. Botany I (w. e. from June, 2019)

Academic Year 2019-2020

Class : M.Sc. (Semester- I)
Paper Code : BOT4101
Paper : I Title of Paper: Plant Systematics I
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To create awareness and need of inculcation knowledge of Cryptogamic diversity.
2. To give idea of economic importance of Cryptogams.

B) Learning Outcome:

1. Expert in cryptogams useful to save Cryptogamic diversity.

TOPICS / CONTENTS:

Credit -1 (20 Lectures) Algae

1.1 Systematics and Taxonomy – Principles, Concept of species and hierarchial taxa, Classification of algae up to order level- Fritsch system **3 L**

1.2 Algological studies – Algal habitats, Pigment constitution in algae, Reserve food, Modes of perennation in algae, Origin and evolution of sex, Contribution of algal studies in India and world.(three)…… **5 L**

1.3 Cyanophyta – Distinguishing characters, thallus organization, ultra-structure of heterocyst and its significance **2 L**

1.4 Chlorophyta- Thallus organization, reproduction – asexual and sexual, life cycle pattern in unicellular, filamentous and multicellular green algae. **4 L**

1.5 Brief Introduction, Comparative structure and reproduction in Charophyta, Euglenophyta, Xanthophyta, Bacillariophyta and Chrysophyta **3 L**

1.6 Phaeophyta and Rhodophyta – External and Internal, reproduction and life cycle patterns. (any one example)… **2 L**

1.7 Applications of algae- Commercial applications of algae - Biofertilizer, Medicine, pollution (Palmer's pollution indices). **1 L**

Credit - 2 (20 Lectures) Fungi

2.1 Thallus structure, Nutrition, Cell structure, Hyphal modifications in Fungi. Classification of fungi as per Ainsworth et al system (1973), Contribution of fungal studies in India and world.(any three). **3 L**

2.2 Myxomycotina - Distinguishing characters, types of plasmodium, fruiting bodies and life cycle pattern **3 L**

2.3 Mastigomycotina - Distinguishing characters, structure of thallus in Chytridiomycetes and Oomycetes **3 L**.

2.4 Zygomycotina - Distinguishing characters, Thallus structure, Heterothallism and sexual reproduction **3 L**.

2.5 Ascomycotina-Thallus structure, Fructifications, Comparative study of Hemiascomycetes and Euascomycetes **2L**.

2.6 Basidiomycotina – Distinguishing characters, thallus structure, types and structure of basidia and basidiocarps **2 L**

2.7 Deuteromycotina – Distinguishing characters, thallus structure, fructifications, types of conidia, conidial ontogeny. **2 L**

Applications of fungi- Biofertilizers, biocotrol, biopesticides, food, disease and medicine **2 L**

Credit - 3 (20 Lectures) Bryophytes

3.1 Introduction, characters, Affinities with thallophytes and pteridophytes, Contributions of bryologists in world and India (any three), Comparative system of classification according to G. M. Smith and R. M. Schster (1972), evolution of sporophyte, theory of sterilization and reduction, apogamy and apospory. **5 L**

3.2 Distribution, Distinguishing characters, morphology and anatomy of gametophyte and sporophytes of following orders. **14 L**

3.3 Takakiales, Calobryales and Sphaerocarpales (3 L), Marchantiales (1L), Jungermanniales

3.4 (2L), Anthocerotales(1L), Sphagnales(1L), Polytrichales(1L), Funariales(1L), Andreaeales (1L), Eubryales(3L).

3.5 Applications of bryophytes- Therapeutical and horticultural **1 L**.

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Fungi :

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Bryophytes:

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3. **Kashyap S.R.** (1929). Liverworts of the Western Himalayas and the Punjab Plain. Part 1, Chronica Botanica, New Delhi.
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8. **Udar R.** (1975). Bryology in India. Chronica Botanica, New Delhi.
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Class : M.Sc. (Semester- I)
Paper Code: BOT4102
Paper : II Title of Paper: Cell Biology
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To study structure of cell organelles and their functions.
2. To pertain knowledge of different cytological techniques.

B) Learning Outcome:

The main outcome of this course is to acquaint students with some cytological techniques.

TOPICS/CONTENTS:

Credit 1 = (15 Lectures)

1.1 Introduction to cell biology- Cell theory and cell structure **1L**

1.2 Cell Wall- Biogenesis, Ultra Structure and function, Growth- primary and secondary wall. **2L**

1.3 Cell membranes- molecular organization, Fluid mosaic model, Membrane protein diffusion, Electrical properties of membranes, Transport across membranes-Facilitated diffusion, Carrier and channel proteins, Transporters, Active transport, Transport of ions and solutes **5L**.

1.4 Molecular organization and biogenesis of chloroplast and mitochondrial membrane **2L**

1.5 Vacuoles- biogenesis, transporters, Mechanism of sorting and regulation of intracellular transport, Role as storage organelle, Transport across vacuolar membrane **2L**

1.6 Endoplasmic reticulum- Ultra structure of ER, Role in synthesis and transport of secretary proteins. **2L**

1.7. Golgi complex- Ultra structure of golgi complex, Role in sorting, storage and secretion **1L**

Credit 2 = (15 Lectures)

2.1 Nucleus- Structure, Organization and regulation of nuclear pore complex, Transport across nuclear membrane **2L**.

2.2 Ribosomes- Structure, Assembly and dissociation of subunits, function **2L**.

2.3 Lysosomes- Ultra structure of lysosomes, Membrane integrity and role. **2L**

2.4 Glyoxysomes and Peroxisomes- Structure and functions **2L**

2.5 Cytoskeleton- Composition and organization of microtubules, microfilaments, signaling and intracellular traffic, Role in motility, flagella- Structure and organization, Intermediate filaments **4L**

2.6 Techniques in cell biology- In Situ hybridization to locate transcripts in cell types, FISH, GISH, confocal microscopy **3L**

Credit 3 = (15 Lectures)

3.1 Signal transduction-Types of receptors G-protein and G-protein coupled receptors. **2L**

3.2 Phospholipid signaling, Ca2+, Calmodulin cascade, Diversity in protein kinases and phosphatases, secondary messengers, regulation of signaling pathways. **3L**

3.3 Specific signaling mechanisms with suitable examples- Biotic and abiotic stress, ABA induced stomatal closure, Stomatal guard cell signaling **3L**.

3.4 Nuclear- organelle signaling during plastid development **1L**.

3.5 Receptor Serine/ Threonine kinase, bacterial and plant two component system. Bacterial chemotaxis and quorum sensing **3L**.

3.6 Cellular communication- general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, and its regulation**. 3L**

Credit 4 = (15 Lectures)

4.1 Cell cycle- Phases of cell cycle, functional importance of each phase, Molecular events during cell cycle, Regulation of cell cycle, Check points, Cyclins and protein kinase, MPF (Maturaton promoting factor). **5L**

4.2 Method of study cell cycle- labeled mitotic curve, flow cytometry, use of mutants. **2L**

4.3 Cell aging and cell senescence, programmed cell death-moleular aspects, regulation of cell death, PCD in response to stress, Apoptosis- Role of different genes, cell organelles during apoptosis, genetic control of apoptosis **5L**.

4.4 Cancer- Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells. **3L**

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Class : M.Sc. (Semester- I)
Paper Code: BOT4103
Paper : III Title of Paper : Genetics and plant Breeding
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To study genetic inheritance and gene interactions in plants.
2. To make aware about different linkage, microbial genetics and plant breeding with its importance in enhancement of economy of country.

B) Learning Outcome:

Knowledge of this paper helps to the student in initial description of the data of chromosomal structural and numerical alterations and breeding techniques in plants.

TOPICS/CONTENTS:

Credit 1 = INHERITANCE OF GENES :(15 Lectures)

1.1 **Principles of Mendelian inheritance and Interaction of genes:- 6L**

a Introduction to genetics

b Early concepts of inheritance

c Mendel's Laws - Dominance, Segregation, Independent assortment, Discussion

d on Mendel's paper, Chi Square test, Probability

e Interaction of genes- Complementary, epitasis, inhibitory, polymeric and additive

1.2. Cytoplasmic inheritance:- 3L

a Mitochondrial and chloroplast genomes

b Inheritance of chloroplast genes (*Mirabilis jalapa* and *Zea mays* Inheritance of mitochondria genes (Petit yeasts and cytoplasmic male sterility in plants)

c Interaction between nuclear and cytoplasmic genes

d Maternal effect in inheritance (*Limnaeaperegra*)

1.3. Inheritance: Quantitative and Sex linked 4L

a Quantitative traits, Continuous variation

b Inheritance of quantitative traits, (Polygenic traits) in - corolla length in *Nicotiana,*

c Cob length in *Zea mays*

d Heritability and its measurement

e Chromosomal theory of inheritance: Inheritance of X and Y linked genes,

f Sex limited and sex influenced genes.

1.4. Population Genetics 2L

a Hardy Weinbergs Law, Factors affecting gene and gene frequencies

b Pedigree analysis in Human genetics, Genomic Imprinting

Credit 2 = ALLELE, LINKAGE ANDRECOMBINATIONS :(15 Lectures)

2.1. Concept of gene, allele, multiple allele, pseudo allele- complementation tests 2L

2. 2Recombination, Linkage and mapping of eukaryotes :- 9L

a Linkage and crossing over

b Recombination in Chromosomes: homologous and non-homologous, sitespecific recombination

c Genetic markers

d Linkage maps, LOD score for linkage testing,

e Mapping by tetrad analysis in Yeast (unordered) and *Neurospora*(ordered)

f Mapping by using somatic cell hybrids

2.3. Mutation: - 4L

a Mutation- causes and detection

b Types of Mutation- lethal, conditional, biochemical, Loss of function, gain of function

c Induced ,Point mutagenesis mutagenesis and Germinal and somatic mutants

Credit 3 = MICROBIAL GENETICS AND CYTOGENETICS: (15 Lectures)

3.1. Microbial Genetics:- 3L

a Methods of genetic transfers- transformation, conjugation and transduction in bacteria

b Genetic recombination in Bacteria

c Mapping of bacterial genome by interrupted mating

3.2. Genetics of phages: 3L

a Lytic and lysogenic cycles in phages

b Genetic recombination, specialized transduction

c Mapping the bacteriophage genome

d Fine structure analysis of rII gene in T4 bacteriophage

3.3. Karyotype: 2L

a Structure and Organization of chromosome, Concept of karyotope

b Karyotype evolution

c Preparation of chromosome for Karyotype and its analysis

d Chromosome banding

e Role of karyotype in plant species identification

3.4. Structural alterations of chromosomes: 3L

a Deletion, duplication, inversion, translocation, complex translocation heterozygotes

b Robert sonian and BA translocations

c Genetic disorders

3.5. Numerical alterations of chromosomes: 4L

a) Classification of polyoploids: cytological and genetical method of identification of autopolyploids and allopolyploids

b) Classification, method of production, identification of aneuploids (Monosomics,

c) Nullisomics and trisomics)

Credit 4 = PLANT BREEDING: (15 Lectures)

4.1. Plant Breeding: - 1L

a) History of plant Breeding in world

b) Objectives of plant breeding,

c) Patterns of evolution and Plant breeding in India.

4.2. Plant Genetic resources: - 2L

a) Centers of origin, distribution and areas of diversity

b) Importance of genetic diversity in crop improvement

c) Importance of genetic diversity in conservation and regulation.

4.3. Reproductive systems, population structure and breeding strategies: - 2L

a) Asexual reproduction

b) Sexual reproduction (Cross and self pollination)

c) Pollination control mechanisms and implications

d) Genetic structure of populations

4.4. Selection methods:- 5L

a) Selection methods in self pollinated and cross pollinated crops

b) Selection methods in asexually propagated crops

c) Marker Assisted selection in plants

4.5. Hybridization: - 3L

a) Hybridization and its role
b) Inter-varietal and wide/distant crosses
c) Plant genetic erosion

4.6. Induced mutations in crop plants: - 2L

a) Physical and chemical mutagens
b) General method of induction of mutations in crop plant
c) Role of induced mutations
d) Induction of polyploidy in crop plants
e) Role of polyploidy in plant breeding

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Class : M.Sc. (Semester- I)
Paper Code : BOT4104
Paper : IV Title of Paper : Advanced Botanical techniques
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To train the students in instrumentation useful in research methodology.
2. To make technosavy students.

B) Learning Outcome:

Enrich student knowledge with advance botanical techniques.

TOPICS/CONTENTS:

Credit 1 = (15 Lectures)

1.1 Image formation (properties of light), Lens- refraction, magnification concept, resolution concept. **2L**

1.2 Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM and TEM), Flow Cytometery **6L**

1.3 Microtomy- serial sectioning, double or multiple staining, Lesser assisted Microtomy **3L**

1.4 Histochemical and cytochemical techniques- Localization of specific Compounds/ reactions/ activities in tissues and cells **3L**

1.5 Micrometry and camera lucida **1L**

Credit 2 = (15 Lectures)

2.1 **Chromatography techniques:-**

Introduction, concept of partition coefficient, Paper, TLC, Column, Gel filtration, Affinity, Ion exchange, HPLC and HPTLC, Gas chromatography (Principle, method and applications of each) **8L**

2.2 **Elctrophoretic techniques:-**

History, Principles, Agarose gel electrophoresis, Pulsed Field Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE/ Native), Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE/ Denaturing), Isoelctric focusing, 2 Dimensional Gel Electrophoresis (2-D method) **7L**

Credit 3 = (15 Lectures)

3.1 **Spectroscopic techniques:-**

General principles, Beer and Lambert's Law, Molar extinction coefficient, Spectrophotometer (working and application), UV-Visible spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, X-ray crystallography, Spectoflurometry, AAS, MS, IR Spectroscopy **9L**

3.2 **Radioactive techniques:-**

Radioisotopes used in biology and their properties, Units of radioactivity, Interaction of radioactivity with matter, Detection and measurement of radioactivity, Autoradiography, Safe handling of radio isotopes, Non-Radio labeled techniques, Green Fluorescent Proteins, Incorporation of radioisotopes in biological tissues and cells, Molecular imaging of radioactive material. **6L**

Credit 4 = (15 Lectures)

4.1 **Centrifugation techniques:-**

Principles, Types (Analytical and Preparative), Rotors and their types, Ultra centrifugation, Density Gradient Centrifugation, High speed centrifuges **4L**

4.2 **Electrochemical techniques:-**

Electrical conductivity, pH meter, Oxygen electrode **2L**

4.3 **Immunological techniques:-**

Principles, Antigen–antibody interaction, Immuno diffusion, Immuno precipitation, Radio-immuno assay, Rocket immumo-electrophoresis, ELISA, In-Situ localization by techniques such as FISH and GISH. **4L**

4.4 Molecular biology techniques:-

DNA sequencing techniques- Sanger's method, Maxam- Gilbert's mehod, Automated DNA sequences, Pyrosequencing, Sequencing of proteins, PCR, DNA microarray **5L**

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Class : M.Sc. (Semester- I)
Paper Code: BOT 4105
Paper : I Title of Paper : Practicals based on BOT. 4101 & 4102
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To study Cryptogamic habit and habitat diversity.
2. Hand on training for the identification and study of methods of reproduction of cryptogams and cell organelles ultrastructure.

B) Learning Outcome:

The main outcome of this course is to develope skilled cryptogamist and cell biologist.

TOPICS/CONTENTS:

Practicals based on BOT. 4101

Practicals on Algae: (Any Four practicals)

1. Morphological observations, documentation (description and illustrations) and classification According to Fritsch with reasons of taxa belonging to:

a. Chlorophyta: Any Four forms. Charophyta: Any one form. **1P**

b. Phaeophyta: Any three forms. Rhodophyta: Any three forms. **1P**

c. Cyanophyta: Any three forms. Minor groups: Any two forms. **1P**

2. Phytochemical analysis of local area sample ($_P$H, Temperature, TDS, EC, COD and BOD) **1P**

Practicals on Fungi: (Four practicals)

1. Study of the representative genera belonging to following sub-divisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth *et al* (1973).

Sub-division: Myxomycotina : Any two forms. Sub-division: Mastigomycotina: Any two forms. **1P**

Sub-division: Zygomycotina : Any one forms. Sub-division: Ascomycotina : Any four forms. **1P**

Sub-division Basidiomycotina : Any two forms. Sub-division: Deuteromycotina **:** Any two forms. **1P**

2. Isolation of fungi from rhizosphere soil **1P**

Practicals on Bryophytes: (Four practicals)

1. Morphological, anatomical and reproductive studies of the following members:

Marchantiales: *Astrella*, *Plagiochasma*, *Targionia* and *Cyathodium.* **1P**

Jungermanniales: *Porella*, *Frullania* **1P**

Anthocerotales: Anthoceros, *Notothylus* **1P**

Sphagnales: *Sphagnum.* Funarilales: *Funaria* **1P**

Polytrichales: *Polytrichum and Pogonatum* **1P**

Andreales: *Andrea.* Eubryales: *Bryum, Hyophila* **1P**

2. Study of antimicrobial properties of bryophytes (any two thalloid and moss) **1P**

Practicals based on BOT 4102: Cell Biology

1. Differential centrifugation for isolation of cell fractions- Nuclear fraction **1P**
2. Isolation of Chloroplasts to study: **2P**
   a. Hill reaction to measure intactness,
   b. Chlorophyll estimation
3. Isolation of mitochondria for: **2P**
   a. Estimation of succinic dehydrogenase activity **2P**
   b. Microscopic observations using MitoTracker Green FM/ MitoTracker Red 580/ Janus green B
4. Isolation of Lysosomal fraction and estimation of acid phosphatase activity **1P**
5. Study of Electron Micrographs of cell organelles **1P**
6. Study of cell cycle using BrdU (demonstration) **1P**
7. Isolation of protoplasts and viability staining to determine % viability **1P**
8. Study of metaphase nucleus: Localization of Euchromatin and heterochromatin **1P**
9. Cytochemical / Histochemical studies of special cell types: guard cells, senescent cells, bundle sheath cells, meristematic cells, laticiferous cells, glandular cells, polle grains **2P**
10. Study of induced cell senescence in leaf discs **1P**
11. Study of programmed cell death in plants **1P**
12. Study of vacuoles from different plants **1P**

Class : M.Sc. (Semester- I)
Paper Code: BOT4106
Paper : I Title of Paper: Prac. based on BOT. 4103 & 4104
Credit : 4 No. of lectures: 60

A) Learning Objectives:

1. To pertain cytological and botanical techniques.
2. To provide the knowledge of different genetic interaction and plant breeding techniques.

B) Learning Outcome:

The learning outcome of this training useful to develop new methods in plant breeding.

TOPICS/CONTENTS:

Practicals based on BOT 4103 Genetics and Plant Breeding (Any 12 Practicals)

1. Preparation of stains, Fixatives, Preservatives and pretreatments to plant material 1P
2. Karyotype analysis, preparation of somatic C- metaphase chromosomes of appropriate material using camera lucida drawing and Karyotype analysis in *Allium* / Aloe. 2P
3. Study of meiotic configuration in maize/ *Allium*, *Rhoeo*/ Aloe, *Tradescantia* (prophase I, Chiasma analysis). 2P
4. Induction of mutation in plant material using suitable mutagen 1P
5. Study of Polygenic inheritance. 1P
6. Problems of Mendelian inheritance and estimation of gene frequencies and heterozygotic Frequencies, population genetics and Linkage. 1P
7. *Neurospora* tetrad analysis. 1P
8. Study of *Drosophilla* sexual dimorphism and mutants 1P
9. Linear differentiation of chromosomes through banding techniques such as C-Banding, Banding and Q-Banding. 2P
10. Penetrance and expressivity of PTC testing ability in humans and tounge rollers/non Rollers 1P
11. Floral Biology, Study of Pollen Viability, germination in vitro and staining (any two major crops) 1P
12. Study of monohybrid and dihybrid cross and interactions. 1P
13. Use of Colchicine for induction of polyploidy in appropriate plant material. 2P
14. Conventional Plant breeding techniques (Emasculation) 1P

Practical's based on BO 4104: Botanical Techniques (Any 12 practicals)

1. Study of Binocular microscope	**1P**
2. Micrometry and Camera Lucida	**2P**
3. Maceration technique	**1P**
4. Electrical conductivity and pH measurements	**1P**
5. Absorption spectra of BSA/DNA & determination of absorption maxima	**2P**
6. Gel filtration	**1P**
7. Rocket immunoelectrophoresis	**1P**
8. Detection of secondary metabolites by using HPLC	**2P**
9. Separation of isozymes by native polyacrylamide gel electrophoresis	**2P**
12. Detection of Radioactivity by using GM Counter	**2P**
13. PCR	**2P**
14. Determination of heavy metals / Minerals by AAS	**2P**

Class : M. Sc. I (Semester- II)
Paper Code : BOT 4201
Paper : I Title of Paper : Plant Systematics – II
Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. Create awareness and need of conservation of Cryptogamic diversity.
2. To give idea of economic importance of cryptogams.

B) Learning Outcome:

1. Students will acquire knowledge of plants life cycle of plants

Credit – 1. (15 Lectures)

1.1 Pteridophytes – Distinguishing characters, origin of Pteridophytes – Algal origin, Bryophyte origin; Apospory, Apogamy, Parthenogenesis, Telome Theory and Stelar Evolution **(5L)**

1.2 Classification of Pteridophytes as per Sporne System (1975), Indian Pteridology, Heterospory and seed habit and Economic importance of Pteridophytes **(3L)**

1.3 Fossil Pteridophytes - Psilopsida : *Rhynia*, Lycopsida : *Lepidodendron Lepidophyllum*, *Stigmaria*, *Lepidostrobus*, *Lepidocarpon*, *Sigillaria*, Sphenopsida : *Calamites*, *Annularia*, *Calamostachys*, *Cheirostrobus* **(7L)**

Credit - 2 (15 Lectures)

2.1 Psilopsida: Distribution, distinguishing characters, morphology and anatomy of sporophyte and gametophyte of *Psilotum* and *Tmesipteris* (**1L)**

2.2 Lycopsida : Distribution, distinguishing characters, affinities, morphology and anatomy of sporophyte and gametophyte of Lycopodiales, Selaginellales, Isoetales and their life cycle pattern **(4L)**

2.3 Sphenopsida : Distribution, distinguishing characters, morphology and anatomy of sporophyte and gametophyte, Life cycle pattern of Equisetales **(2L)**

2.4 Pteropsida / Filicophyta : Distribution, distinguishing characters, morphology and anatomy of sporophyte and gametophyte of order Ophioglossales (1L), Marattiales (2L), Osmundales (1L), Filicales (2L) Marsileales (1L), Salviniales (1L) **(8L)**

Credit - 3 (15 Lectures)

3.1 Gymnosperm : Distinguishing characters, distribution, affinities of gymnosperms with pteridophytes and angiosperms and economic importance of gymnosperms. **(4L)**

3.2 Classification of gymnosperm as per Sahni (1920), Chamberlain (1934), Raizda and Sahni (1960), Sporne (1965) and Bierhorst (1971) **(3L)**

3.3 Pteridospermales w.r.t general characters- *Lyngiopteris*, *Heterangium*, *Medullosa*, *Neuropteris*, *Glossopteris* and *Caytonia.* **(4L)**

3.4 Cycadeoidales- General characters, structure of *Cycadeoidea* and *Williamsonia* **(1L)**

3.5 Pentoxylales- General characters, *Pentoxylon*, structure of secondary wood, male and female strobili, and contribution of Birbal Sahni **(2L)**

3.6 Cordaitales – General characters, structure of *Cordaites*, and *Cordaitanthus* **(1L)**

Credit - 4 (15 Lectures)

General characters, affinities, morphology of sporophytes and gametophytes of living gymnosperm orders :

4.1 Cycadales **(3L)**

4.2 Ginkgoales **(2L)**

4.3 Coniferals **(5L)**

4.4 Gnetales, Ephedrales and Welwitschiales **(5L)**

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Class : M. Sc. I (Semester- II)
Paper Code : BOT 4202
Paper : II Title of Paper : Plant Physiology and Biochemistry
Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To give knowledge of physiological processes which occurs in plants.
2. To make aware about structure and role of biomolecules in plants.

B) Learning Outcome:

1. Development of expertise in plant physiology and biochemistry.

Credit 1 = (15 Lectures)

1.1 Introduction, present status of plant physiology in India and abroad 1L

1.2 Photosynthesis: - 8L

Photosynthetic pigments, absorption and transformation of radiant energy, Light Harvesting complexes, Kok curve, Kautsky curve, ETS, photo inhibition O_2 and H_2 evolution, Regulation of Calvin cycle, RUBISCO activity, Photorespiration, CAM, C4 Pathway and its types.

1.3 Respiration 6L

EMP pathway, TCA cycle, PPP, Mitochondrial ETS, Cyanide resistance pathway, Gluconeogenesis, High energy compounds: Synthesis and utilization, ATP synthesis, Alternate oxidase, Photorespiratory pathway, Significance of Photorespiration and dark respiration.

Credit 2 = (15 Lecture)

2.1 Overview of Solute Transport 5L

Uptake, Transport and translocation of water, ions, solutes and macronutrients from soil through cells, across membranes, through xylem and phloem, transpiration, mechanism of ATP driven active transport (Phloem loading and unloading) Diffusion, Uniport, Symport, Antiport channels.

2.2 Nitrogen metabolism 4L

Nitrate and ammonium assimilation amino acid biosynthesis

2.3 Stress Physiology 2L

Response of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. Mechanism of resistance to biotic stress and tolerance to abiotic stress.

2.4 Plant growth regulators **4L**

Biosynthesis and action mechanism of Auxins, Gibberellins (GA), Cytokinins, Ethylen and Abscisic Acid,

Credit 3 = (15 Lectures)

3.1 Energy Dynamics **3L**

Structure of atoms, molecules and chemical bonds, Principles of thermodynamics, free energy, Redox potentials, Dissociation and associations constants, Activation energy, Binding energy.

3.2 Principles of biophysical chemistry **3L**

pH, buffer, reaction kinetics, thermodynamics, colligative properties. Ions and electrical potentials – Nerst and Goldman equations

3.3 Enzymology **4L**

General classification of Allosteric mechanism, Isozymes, Factors affecting enzyme activity, Enzyme Kinetics, Michaelis – Menton equation, Competitive, uncompetitive and non competitive inhibition.

3.4 Amino acids and proteins **5L**

General classification of amino acids and proteins, Structure, synthesis and properties of amino acids, protein structure (Primary, secondary, tertiary and quaternary), Ramchandran plot.

Credit 4 = (15 Lectures)

4.1 Nitrogen metabolism **3L**

Nitrate and ammonium assimilation, Nitrogen uptake, NOD factor, root nodulation and nitrogen fixation.

4.2 Secondary metabolites **5L**

General classification of Major pathways, Phenolics (Lignins, tannins) Flavonoids, terpenoids (steroids), Alkaloids, pigments (Carotenoids, Anthocynins)

4.3 Carbohydrates metabolism **3L**

General classification, Synthesis and breakdown of carbohydrates (starch, glycogen, pectin, Glucose)

4.4 Lipid metabolism **4L**

General classification of Phospho, Spingo, Glyco Lipid biosynthesis and oxidation.

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Class : M. Sc. I (Semester- II)

Paper Code : BOT 4203

Paper : III Title of Paper : Mol.Biol. & Genetic Engineering

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To give knowledge about nucleic acid structure, role and synthesis of protein.
2. To make aware about methods required for r- DNA technology.

B) Learning Outcome:

1. Experts required in future for genetic library of plants.

Credit 1 = (15 Lectures)

1.1 Structure and Properties of Nucleic acids: - 8L

a. Structure, Chemical, Physical, properties of nucleic acids.forms of DNA. (A, B, C, Z).
b. Packaging of genome in viruses, bacteria, organelle and nuclei structure of
c. chromatin, nucleosome.
d. Dissociation and reassociation kinetics of DNA,hypo and hyperchromicityof DNA, C-value paradox, Cot curves and its significance.

1.2 DNA Replication: - 4L

a. Mechanism of prokaryotic and eukaryotic DNA replication, enzymes involved inreplication.
b. Origins of replication and replication fork
c. Rolling circle and theta (Ø) models in prokaryotes
d. Fidelity of replication, Extrachromosomal replications.

1.3 DNA damage and repair: - 3L

a. Types of DNA damage,
b. Enzymes involving in repairing of DNA,
c. Type of DNA repair, Photoreactivation, excision repair, recombination repair and
d. Mismatch repair systems, SOS.

Credit 2 = (15 Lectures)

2.1 Structural organization of Gene 2L

a. Organization and Structure of prokaryotic and eukaryotic genes;
b. Structure and role of promoters, enhancers and terminators, exons and introns.

2.2 RNA synthesis and processing (Transcription) 5L

a. Structure and function of different types of RNA.(t-RNA, r-RNA and m-RNA)
b. Transcription apparatus.
c. RNA polymerases and their role.
d. Transcription in prokaryotes and eukaryotes- Initiation, elongation and termination.
e. RNA processing- RNA editing caping, methylation, polyadenation and splicing
f. Ribonucleoproteins

2.3 Translation and Protein synthesis 4L

a. Mechanism of Translation in prokaryotes and eukaryotes (Initiation, elongation and termination)
b. Translational and post translational modifications.
c. Targeting of organelle proteins.
d. Protein folding and processing, translational inhibitors.

2.4 Controlling factors of Transcription: - 4L

a. Operon concept (Lac, Tryptophan, Arabinose) - Positive and negative regulation
b. Role of chromatin in gene expression and gene silencing

Credit 3 = (15 Lectures)

3.1 Introduction to recombinant DNA technology 6L

Steps involved in construction of recombinant DNA molecule,Enzymeused in genetic engineering: Restriction endonucleases,Exonucleases, Ligases, Polymerases, Kinase, Phosphatase and Reverse transcriptase

3.2 Vector in recombinant DNA technology 6L

a. Plasmids: pUC, pBR etc., Phages: Lambda and T4 phages, Cosmids, BACs and YACs, Shuttle vectors,
b. Ti-plasmids and Ri- plasmids, Plant DNA viruses

3.3 Screening and selection of recombinants (Plasmids and phages) 3L

Credit 4 = (15 Lectures)

4.1 Isolation of gene and gene libraries 3L

a. Techniques of DNA isolation and methods of purification
b. Preparation of cDNA ,Genomic DNA library, cDNA libraries

4.2 Plant Genetic Engineering 6L

1. Gene Transfer Methods- direct and indirect gene transfer in plants.
2. *Agrobacterium* mediated Gene transfer methods
3. Screening for transformants
4. Transgenic plants- molecular approaches

4.3 Blotting Methods **2L**

a. Southern, Northern, Western, and Dot Blot method

4.4 Application of Genetic Engineering **4L**

a. Transgenic plants for insect, fungal, bacteria disease resistance
b. Lignin modification,
c. Genomics and its application to health and agriculture - gene therapy.

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Class : M. Sc. I (Semester- II)

Paper Code : BOT 4204

Paper : IV Title of Paper : Plant Ecology and Biodiversity

Credit : 4 No. of lectures : 60

A) Learning Objectives:

1. To generate awareness on habit of plants with reference to its habitats and conservation of ecology.
2. To make knowledgeable persons in evolution flora.

B) Learning Outcome:

Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

Credit-1 = (15 Lectures)

1.1Basic Ecological Concept **4L**

Habitat ecology, systems ecology, synecology, autecology; Ecosystem concept; Structure and functions of biotic and abiotic components; Energy in ecosystems; Energy exchange and productivity-food chains and food webs-ecological pyramids

1.2 Niche: **2L**

Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement

1.3Plant relation with the environment **4L**

Plant relation with the climatic factors, edaphic factors, Hydrological Factors. Plant distribution with respect to topographic factors.

1.4 Conservation ecology: **5L**

Principles of conservation, major approaches to management, Environmental Education Programmes : WWF, IUCN, MAB, UNESCO, UNEP,
Environment impact Assessment (EIA)

Credit 2 = (15 Lectures)

2.1Population Ecology **7L**

Characteristics of population, population growth curves, factors affecting population size, Life history strategies, r and k selection, C-S-R triangle, Concept of metapopulation, extinction events, age structured population.

2.2Community Ecology **4L**

Nature of communities; community structure and attributes; levels of species diversity and its measurement

2.3 Diversity types and levels (alpha, beta, gamma), ecotone and edge effect **4L**

Credit-3 = (15 Lectures)

3.1 Ecosystem Ecology **7L**

Ecosystem: Components and organization; energy flow in ecosystem; mineral cycling (C, N,P); primary production and decomposition; structure and function of some ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

3.2Ecological Succession **3L**

Plant succession: Autogenic and allogenic, mechanism and phases; mechanisms; changes involved in succession; concept of climax. Cerial communities and climax communities: Hydroseres, lithoseres, xeroseres, haloseres

3.3Applied Ecology **5L**

Environmental pollution its impact (Air, water, soil and noise) global environmental change; biodiversity: status, monitoring and documentation; major drivers of biodiversity change; biodiversity management approaches. carbon sequestration.

Credit 4: Biodiversity

4.1 **Biodiversity:** Concept, Scope and definitions, types of biodiversity- genetic diversity, species Diversity, ecosystem diversity 2L

4.2 **Value and use of biodiversity**- Ethical, aesthetic, food, fodder, ornamentals, medicinal, economical and socio-ecological approach etc 2L

4.3 **Loss of biodiversity**: Factors affecting diversity, natural verses anthropogenic, loss of biodiversity and its consequences on the human life. Factors affecting loss of genetic diversity, species diversity and ecosystem diversity 4L

4.4 **Conservation of Biodiversity:** **7 L**

Indian initiatives in biodiversity conservation- biodiversity act 2002, Biodiversity Rules, 2004, national biodiversity strategy and action plan (NBSAP), Plant Varieties Protection and Farmer's Rights Act, 2001, National biodiversity authority (NBA) etc; protected area network (PAN)- ecological sensitive zone; important protected areas of India

International program for biodiversity conservation, convention on biological diversity (CBD), CITES, Kyoto Protocol, Ramsar Convention on Wet Lands,

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Class : M. Sc. I (Semester- II)

Paper Code : BOT 4205

Paper : Practicals based on BOT 4201and BOT 4202

A) Learning Objectives:

1. To generate awareness on habit of plants with reference to its habitats and conservation of ecology.
2. To train skilled students in physiological and biochemical techniques.

B) Learning Outcome:

Appreciate the ethical, cross-cultural and historical context of environmental issues and the links between human and natural systems.

Practicals Based on Based on BOT 4201 (Any 12 Practicals)

Pteridophytes : Morphological, anatomical and reproductive studies

1. Psilopsida: *Psilotum* and *Tmesipteris* (Figure of *Tmesipteris* must be shown) *(*1P)
2. Lycoposida and Sphenopsida: *Lycopodium, Selaginella, Equisetum, Isoetes* (2P)
3. Pteropsida: *Ophioglossum, Angiopteris*, *Osmunda*, *Salvia*, *Azolla, Marsilea, Lygodium, Pteris, Adiantum, Gleichenia*, *Cheilanthus*, *Blechnum, Acrostichum* (4P)
4. Fossil Pteridophytes: Any eight forms (At least one from each group) (2P)

Gymnosperms :

5. Study of external, internal and reproductive morphology of *Cycas* and *Zamia* (1P)
6. Study of external, internal and reproductive morphology of *Pinus*, *Cupressus*, *Araucaria*, *Agathis* and *Podocarpus* (1P)
7. Study of external, internal and reproductive morphology of *Gnetum* and *Ephedra* (1P)
8. Study of fossil specimens of gymnosperm (any six) from order Pteridospermales, Cycadeoidales and Pentoxylales (1P)

Note: Botanical excursion tour is compulsory to study Pteridophytes and Gymnosperms, submission of tour report and any 10 photographs of Pteridophytes and Gymnosperms of each is mandatory at the time of practical examination.

Practicals Based on Based on BOT 4202 (Any 12 Practicals)

1. Preparation of solution of different concentrations, Buffers, Conductivity and pH Measurements 1P
2. Enzyme assays – extraction and estimation of enzyme activity- Catalase//peroxidase 1P
3. Effect of substrate concentration on rate of enzyme action and calculation of Km by Michalie's Menten Curve 2P
4. Estimation of soluble proteins in germinating seeds by Lowry's method 2P
5. Estimation of total free amino acid in germinating and non germinating seed 1P
6. Isolation and estimation of chlorophylls and carotenoids. Separation of pigment using column Chromatography. 2P
7. Estimation of ascorbic acid in ripe and unripe fruits 1P
8. Studies on induction of amylase activity by GA 3 in germinating cereal grains 1P
9. Estimation of reducing sugars 1P
10. Estimation of lipids. 1P
11. Effect of salt stress on proline accumulation and its estimation 1P

Class : M. Sc. I (Semester- II)

Paper Code : BOT 4206

Paper : Practicals based on BOT 4203 and BOT 4204

A) Learning Objectives:

1. To give hands on training on molecular techniques and analysis of water and soil.
2. To provide the knowledge required for the molecular biologist and ecologist.

B) Learning Outcome:

Skilled molecular biologist and ecologists can help to solve the critical problems related with plant diseases and improvement of characteristics of plants.

Practical's based on BOT 4203 Molecular Biology and Genetic engineering (Any 12 Practicals)

1. Isolation of Plasmid DNA and quantification **2P**
2. Electrophoretic separation of plasmid isoforms. **1P**
3. Restriction digestion of plasmid DNA, electrophoresis and molecular weight determination of DNA fragments. **2P**
4. Isolation of plant genomic DNA and quantification. **2P**
5. Effect of temperature and alkali on absorption of DNA: hyperchromicity **1P**
6. Separation of seed storage proteins from leguminous seeds and quantification of each fraction **2P**
7. SDS-PAGE separation of seed storage proteins from legumes. Determination of molecular size of the globulin subunits. **3P**
8. Isolation of RNA and its quantification by UV-spectrophotometer **2P**

Practicals based on BOT 4204 Plant Ecology and Biodiversity

1. Determination of frequency, density, abundance, dominance of the species among the plant communities using quadrat method **1P**
2. Study of vegetation by line /belt transect method **2P**
3. Interpretation of satellite imageries and aerial photographs with respect to major vegetation. **1P**
4. Measurement of different Biodiversity Indices : Simpson's and Shannon's biodiversity Index 2P
5. Mapping of vegetation in given area using GPS. 1P
6. Physicochemical analysis of soil - Water holding capacity, Mg, Ca. **2P**
7. Physicochemical analysis of water (clean and polluted): -Hardness, Cl **2P**

8. Biological analysis of water samples (clean and polluted): Phytoplankton 1P
9. Biological analysis of water samples (clean and polluted): DO, CO_2 2P
10. Comparison of stomata index and pollen fertility of the plants from polluted and non-polluted area **1P**